Terrebonne
GENERAL HEALTH SYSTEM

HEALTH AND WELLNESS CENTER

Project Manual

15 October 2025 | **Bid Documents**

Hospital Service District No. 1 of the Parish of Terrebonne
8166 Main Street
Houma, LA 70360

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Board Chair
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Arlanda Williams

AQ STUDIOS
ARCHITECTURE

AQ Studios, 1100 Poydras Street, Suite 3550, New Orleans, LA 70163 **AQ Project # 21001**

SECTION 00 01 10 – TABLE OF CONTENTS

INTRODUCTORY INFORMATION

00 01 10 Table of Contents

00 01 13 Project Directory

00 10 00 Advertisement For Bids

PROCUREMENT REQUIREMENTS, CONTRACT FORMS & CONTRACT CONDITIONS

00 21 13 Instructions to Bidders

R-1020 Designation of Construction Contractor as Agent of a Governmental Entity And Exemption Certificate

Bid Form

Attestation Affidavit

Verification Legal Citizen Affidavit

Corporate Resolution

General Conditions of the Contract for Construction (AIA A201-2017) (with integrated Supplemental General Conditions)

Bid Bond (AIA A310-2010)

Performance Bond (AIA A312-2010)

Payment Bond (AIA A312-2010)

Contractor's Affidavit Attesting to Non-Solicitous Activity

Standard Form of Agreement Between Owner and Contractor (A101-2017)

Change Order (AIA G701-2017)

Application and Certificate for Payment and Continuation Sheet (AIA G702 / G703-2017)

Contractor's Affidavit of Payment of Debts and Claims (AIA G706-1994)

Contractor's Affidavit of Release of Liens (AIA G706A-1994)

Certificate of Substantial Completion (AIA G704-2017)

Consent of Surety to Final Payment (AIA G707-1994)

00 83 00 Construction and Design Policy and Procedures

00 84 00 Interim Life Safety Measures

Interim Life Safety Measures (I.L.S.M.) Contractor's Daily Inspection Check List

00 84 30 Infection Control Risk Assessment

00 84 40 Infection Control Construction Permit

00 84 50 Infection Control Daily Inspection Checklist

Request for Information

DIVISION 01 GENERAL REQUIREMENTS

01 10 00 Summary

01 25 00 Substitution Procedures and Substitution Request Form

01 26 00 Contract Modification Procedures

01 29 00 Payment Procedures

01 31 00 Construction Schedules

01 31 13	Project Coordination via BIM
01 31 14	Coordination Commissioning Agent and General Requirements
01 31 19	Project Meetings
01 31 20	Project Coordination
01 32 33	Photographic Documentation
01 33 00	Submittal Procedures
01 33 01	Submittals - Commissioning
01 35 73	Delegated Design Requirements
01 40 00	Quality Requirements
01 42 20	References
01 50 00	Temporary Facilities and Controls
01 60 00	Materials and Equipment
01 73 29	Execution
01 74 19	Construction Waste Management
01 77 00	Closeout Procedures
01 77 13	Project Close Out - Commissioning
01 78 23	Operation and Maintenance Data
01 78 24	Commissioning Operations and Maintenance Data
01 78 39	Project Record Documents
01 79 00	Demonstration and Training
01 90 00	Envelope Testing and Mockup
01 91 13	Commissioning Requirements

DIVISION 02 EXISTING CONDITIONS – NOT USED

DIVISION 03 CONCRETE

03 30 00	Cast-In-Place Concrete
03 33 01	Sheet Vapor Barriers
03 54 00	Cement Based Finishing Underlayment

DIVISION 04

04 20 00	Unit Masonry
04 72 00	Cast Stone Masonry

DIVISION 05

05 12 00	Structural Steel Framing
05 21 00	Steel Joists
05 31 00	Steel Decking
05 40 00	Cold Formed Framing
05 45 00	Metal Support Assemblies
05 50 00	Metal Fabrications
05 51 00	Metal Stairs

05 52 13 Pipe and Tube Railings
05 73 13 Glazed Decorative Metal Railings

DIVISION 06 WOOD, PLASTICS AND COMPOSITES

06 10 00 Rough Carpentry
06 10 53 Miscellaneous Carpentry
06 36 61.13 Plastic-Laminate-Clad Countertops
06 36 61.16 Solid Surface Fabrications
06 36 61 Simulated Stone Fabrications
06 40 23 Interior Architectural Woodwork (includes Plastic-Laminate Cabinets)

DIVISION 07 THERMAL AND MOISTURE PROTECTION

07 13 00 Sheet Waterproofing
07 13 13 Underslab Vaporproofing/Waterproofing Membrane
07 16 14 Polymer Modified Cement Waterproofing
07 16 16 Crystalline Waterproofing
07 18 00 Traffic Coating
07 19 00 Water Repellants
07 21 00 Thermal Insulation
07 21 19 Foamed-In-Place Insulation
07 27 26 Fluid Applied Membrane Air Barriers and Vapor Barriers
07 42 13.24 Aluminum Metal Wall
07 42 64 Metal Composite Material Wall Panels
07 42 93 Soffit Panels
07 52 16 Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing
07 62 00 Sheet Metal Flashing and Trim
07 71 00 Roof Specialties
07 71 23 Manufactured Gutters and Downspouts
07 72 00 Roof Accessories
07 76 13 Roof Pavers and Ballast Materials
07 81 00 Applied Fireproofing
07 84 13 Penetration Firestopping
07 84 46 Fire-Resistive Joint Systems
07 92 00 Joint Sealants
07 95 13 Expansion Joint Cover Assemblies

DIVISION 08 OPENINGS

08 11 13 Hollow Metal Doors and Frames
08 14 23 Impact Resistant Doors (Flush)

08 31 13	Access Doors and Frames
08 33 23	Overhead Coiling Door
08 34 49	Radiation Shielding Doors and Frames
08 35 13.23	Accordion Folding Fire Doors
08 42 10	All Glass Doors
08 42 29.43	Sliding Automatic Entrances
08 43 13	Aluminum-Framed Storefronts and Doors
08 44 13	Glazed Aluminum Curtain Walls
08 71 00	Door Hardware
08 71 13	Automatic Door Operators
08 80 00	Glazing
08 83 00	Mirrors
08 90 00	Louvers and Vents

DIVISION 09 FINISHES

09 21 16	Gypsum Board Assemblies
09 22 16	Non-Structural Metal Framing
09 30 00	Tiling
09 51 23	Acoustical Tile Ceilings
09 54 16	Luminous Sky-Image Ceilings
09 54 23	Linear Metal Ceiling Panels
09 65 13	Resilient Base and Accessories
09 65 19	Resilient Tile Flooring
09 65 66.13	Resilient Athletic Flooring
09 65 66.16	Poured Resilient Athletic flooring
09 66 23	Epoxy Terrazzo
09 68 13	Carpet Tile
09 83 19	Acoustic Wall Panels
09 84 00	Acoustic Soundproofing Membrane
09 84 33	Acoustical Ceiling Baffles
09 91 23	Interior and Exterior Paints
09 96 00	High Performance Coatings

DIVISION 10

10 11 00	Glassboards
10 22 26	Operable Partitions
10 28 00	Toilet Accessories
10 44 13	Fire Extinguisher Cabinets
10 44 16	Fire Extinguishers
10 56 13	Metal Storage Shelving
10 71 13	Exterior Sun Control Devices

DIVISION 11

11 66 23	Gym Equipment

DIVISION 12 FURNISHINGS

12 25 13	Roller Shades
12 80 00	Pool Bleachers - Aluminum

DIVISION 13 SPECIAL CONSTRUCTION

13 09 50	RF Shielding Assemblies
13 11 00	Swimming Pools
13 11 03	Swimming Pool Tile
13 11 04	Swimming Pool Cementitious Finish
13 11 06	Swimming Pool Timing System
13 24 16	Saunas and Steam Rooms
13 49 13	Integrated X-Ray Shielding Assemblies

DIVISION 14 CONVEYING EQUIPMENT

14 21 23	Electric Traction Passenger Elevators

DIVISION 21 FIRE SUPPRESSION

21 00 00 Fire Protection System
21 13 13 Wet-Pipe Sprinkler Systems

DIVISION 22 PLUMBING

22 10 00 Plumbing Piping (For Projects in Louisiana)
22 10 10 Plumbing Specialties
22 40 00 Plumbing Fixtures

DIVISION 23

23 00 00 General Mechanical
23 01 00 Mechanical Coordination Drawings
23 05 00 Basic Materials and Methods
23 05 13 Motors
23 05 15 Variable Frequency Drives
23 05 16 Expansion Compensation
23 05 23 Valves
23 05 29 Supports and Anchors
23 05 48 Vibration Isolation
23 05 53 Mechanical Identification
23 05 93 Testing, Adjusting and Balancing
23 07 00 Piping and Equipment Insulation
23 09 00 - HVAC Temperature Controls
23 21 13 Hydronic Piping
23 21 16 Hydronic Specialties
23 21 23 Pumps
23 25 00 Chemical Water Treatment
23 31 00 Ductwork
23 34 10 General Exhaust System
23 34 23 Power Ventilators (In-Line)
23 36 00 Air Terminal Units
23 37 00 Air Outlets And Inlets
23 61 10 - Variable Speed Water-Cooled Screw Chillers
23 65 00 Induced Draft Cooling Tower
23 70 00 Central Station Air Handler
23 84 19 - POOL DEHUMIDIFICATION UNITS

COMMISSIONING

23 00 01-Mechanical General Provisions
23 08 10-Mechanical Systems Commissioning
23 08 11-Mechanical Testing Requirements
23 08 12-Commissioning Pre-Functional Checklists
23 08 13-Mechanical Functional Test Procedures
23 09 05-Automatic Temperature Controls - Commissioning
26 00 00-Electrical General Provisions - Commissioning
26 08 10-Electrical Systems Commissioning
26 08 11-Electrical Testing Requirements
26 08 12-Electrical Pre-Functional Checklists
26 08 13-Electrical Functional Test Procedures

DIVISION 26 ELECTRICAL

26 05 74 Overcurrent Protective Device Arc-Flash Study
26 09 13 Electrical Power Management System
26 09 15 Electrical Power Monitoring And Control
26 09 21 - Digital Lighting Control System
26 09 22 - Analog Lighting Control Devices
26 09 23 Lighting Control System
26 09 26 Lighting Control Devices
26 20 00 Service And Distribution
26 22 00 Low-Voltage Transformers
26 24 13 – Switchboards
26 24 16 Panelboards
26 25 00 Enclosed Bus Assemblies
26 25 50 - Generator Docking Station
26 27 13 Electric Metering
26 27 26 Wiring Devices
26 28 11 - Low-Voltage Power Circuit Breakers
26 28 13 Fuses
26 28 16 Enclosed Switches And Circuit Breakers
26 32 13 Diesel Generator Set Specification
26 36 00 Transfer Switches
26 41 00 Lightning Protection System
26 43 13 Surge Protection Devices For Low Voltage Electrical Power Circuits
26 50 00 Lighting

DIVISION 27 COMMUNICATIONS

27 00 00 Telecommunication Systems
27 11 00 Communication Equipment Room Fittings

DIVISION 28 ELECTRONIC SAFETY AND SECURITY

28 31 00 Fire Alarm And Detection System

DIVISION 31 EARTHWORK

31 00 01 Earthwork for Building Foundation

31 31 16 Termite Control Improvements

31 62 01 Steel Pipe Piles

DIVISION 32 EXTERIOR IMPROVEMENTS

32 31 13 Chain Link fences and Gates

CIVIL SPECIFCATIONS

ATTACHED: UPDATED SURVEY, SEPTEMBER 29, 2025
ATTACHED: GEO TECHNICAL REPORT, APRIL 25, 2024

SECTION 00 01 13 – PROJECT DIRECTORY

OWNER/USER
Hospital Service District No. 1 – Terrebonne Parish
Terrebonne General Health System
8166 Main Street
Houma, LA 70360
Tel: 985.873.4141

ARCHITECT
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SECTION 00 10 00 – ADVERTISEMENT FOR BIDS

Sealed bids will be received by Hospital Service District No. 1 – Parish of Terrebonne, Terrebonne General Health System, 8166 Main Street, Houma, Louisiana 70360, until the hour of **two o'clock (2:00 P.M.) local time on the afternoon of Thursday, December 11, 2025.**

TGHS – HEALTH AND WELLNESS CENTER
TERREBONNE GENERAL HEALTH SYSTEM
885 Westside Blvd. Extension
Houma, Louisiana 70360
Project Number: 21001.RW

Any bid received after the above time and date stated will be returned unopened.

All bids on hand will be publicly opened and read aloud at the hour of **two o' clock (2:00 P.M.) at Terrebonne General Health System, 8120 Main Street, Houma, Louisiana 70360 in the Atrium Auditorium**

Complete Bidding Documents for this project are available in electronic form. They may be obtained from City Blueprint & Supply Company. Printed copies are not available from the Architect but arrangements can be made to obtain them through most reprographic firms. Plan holders are responsible for their own reproduction. Questions about this procedure and requests for a list of plan holders shall be directed to:

City Blueprint & Supply Company
1904 Poydras Street
New Orleans, Louisiana 70112
Phone: 504-522-0387
Fax: 504-522-2542
E-mail: planroom@cityblueprint.com

Other questions about the project shall be directed in written form to the Architect:

AQ Studios Architecture
1100 Poydras Street, Suite 3550
New Orleans, Louisiana 70163
Phone: 504-524-4375
Fax: 504-524-2493

Giulia Irwin – Project Architect
giulia@aqteam.com

Gregory D'Amico – Principal Architect
greg@aqteam.com

Bids must be submitted on the blank Bid Form furnished with the specifications, per Instructions to Bidders.

Each bid shall be accompanied by Bid Security (bid bond, cash, money order, certified or cashier's check) in an amount equal to at least five (5%) percent of the total bid as per Instructions to Bidders.

Bids shall be accepted from Contractors who are licensed under LA. R.S. 37:2150-2163 for the classification of BUILDING CONSTRUCTION.

Bids will only be accepted from contractors attending a **MANDATORY ON-SITE PRE-BID CONFERENCE** scheduled for **ten o' clock (10:00 A.M.) in the morning of Wednesday, November 12, 2025, at Terrebonne General Health System, 8120 Main Street, Houma, Louisiana 70360 in the Atrium Auditorium.**

Bids may also be submitted electronically by going to www.BidSync.com. Contractors opting to submit an electronic bid will be required to register on the website and pay a recurring service fee for this service.

No bid may be withdrawn after the closing time for receipt of bids for at least forty-five (45) calendar days.
The Owner reserves the right to reject any and all bids for just cause.

Publication dates in the Houma Dailly Courier are as follows:

1st Advertisement for Bid:	October 24, 2025
2nd Advertisement for Bid:	October 27, 2025
3rd Advertisement for Bid:	November 6, 2025

TERREBONNE GENERAL HEALTH SYSTEM
8166 MAIN STREET
HOUMA, LOUISIANA 70360

END OF SECTION 00 10 00

DIVISION

00

PROCUREMENT

SECTION 00 21 13 – INSTRUCTIONS TO BIDDERS

COMPLETION TIME

The Bidder shall agree to fully complete the contract within **_five hundred and forty (540) consecutive calendar days,** subject to such extensions as may be granted under Paragraph 8.3, in the General Conditions, and acknowledges that this construction time will start on or before the date specified in the written "Notice to Proceed" from the Owner.

DEFINITIONS

Bidding Documents include the following:

Advertisement for Bids
Instructions to Bidders
R-1020 Designation of Construction Contractor as Agent of a Governmental Entity And Exemption Certificate
Louisiana Uniform Public Work Bid Form
Attestation Affidavit
Verification Legal Citizen Affidavit
Corporate Resolution
General Conditions of the Contract for Construction (AIA A201-2017) (with integrated Supplemental General Conditions)
Bid Bond (AIA A310-2010)
Performance Bond (AIA A312-2010)
Payment Bond (AIA A312-2010)
Contractor's Affidavit Attesting to Non-Solicitous Activity
Standard Form of Agreement Between Owner and Contractor (A101-2017)
Change Order (AIA G701-2017)
Application and Certificate for Payment and Continuation Sheet (AIA G702 / G703-2017)
Contractor's Affidavit of Payment of Debts and Claims (AIA G706-1994)
Contractor's Affidavit of Release of Liens (AIA G706A-1994)
Certificate of Substantial Completion (AIA G704-2017)
Consent of Surety to Final Payment (AIA G707-1994)
Exhibit 1 - Drawings, dated 10.15.25
Exhibit 2 - Technical Specifications, Divisions 00 through 28, dated 10.15.25
Addenda issued during the bid period and acknowledged on the Louisiana Uniform Public Work Bid Form.

All definitions set forth in the General Conditions of the Contract for Construction (AIA A201 - 2017), as amended or in other Contract Documents, are applicable to Bidding Documents.

Addenda are written and/or graphic instruments issued by the Architect prior to the opening of bids that modify or interpret the Bidding Documents by additions, deletions, clarifications, corrections and prior approvals.

Bid is a complete and properly executed proposal to do the Work or designated portion thereof for the sums stipulated therein, submitted in accordance with the Bidding Documents.

Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

Alternate Bid (or Alternate) is an amount stated in the Bid to be added to the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

Bidder is a person or entity who submits a Bid for a prime Contract with the Owner for the Work described in the Bidding Documents.

Sub-bidder is a person or entity duly licensed in accordance with the laws of the State of Louisiana who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

BIDDER'S REPRESENTATIONS

Each Bidder by making a Bid represents that:

The Bidder has read and understands the Bidding Documents and his Bid is made in accordance therewith.

The Bidder has visited the site and has familiarized himself with all conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the Bidding Documents.

The Bidder has informed himself fully of the employment of labor necessary to perform the Work as intended. Failure to do so will not relieve a Bidder of his obligation to furnish labor as necessary to carry out the provisions of the Bidding Documents.

The Bid is based upon the materials, equipment and systems described in the Bidding Documents as advertised and/or modified by Addenda, without exception.

The Bid is not based on any verbal instructions contrary to the Contract Documents and Addenda.

The Bidder is a fully qualified and licensed Louisiana Contractor under the provisions of LA R.S. 37.2150, et. seq. Bidder shall be responsible for determining that each Sub-bidder or prospective Subcontractor is duly licensed in accordance with Louisiana law.

BIDDING DOCUMENTS

COPIES

Bidding Documents may be obtained in electronic format without charge and without deposit from City Blueprint & Supply Company as stated in the Advertisement for Bids.

Printed complete sets of Documents are available to Bidders upon request at the Bidder’s expense.

Complete sets of Bidding Documents shall be used in preparing bids; neither the Owner nor the Architect assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

The Architect, in making copies of the Bidding Documents available on the above terms, does so only for the purpose of obtaining bids on the Work and does not confer a license or grant for any other use. Contract Documents remain the exclusive property of TGHS and shall be returned to a TGHS agent.

INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

Bidders shall carefully study and compare Bidding Documents with each other, examine the site and local conditions to the extent relating to the Work for which the Bid is submitted, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect, to be received by him not later than seven (7) days prior to the last date for receipt of Bids.

Interpretations, corrections and changes of the Bidding Documents will be made only by written Addendum. Interpretations, corrections and change of the Bidding Documents made in any other manner will not be binding and Bidders shall not rely upon them.

SUBSTITUTIONS

The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. No substitutions shall be allowed after bidding.

No substitutions prior to receipt of Bids will be considered unless written request for approval has been received by the Architect at least seven (7) calendar days prior to the last date for receipt of Bids. Each such request, to be considered, shall include:

1. Name or identification of the item on which a substitution is requested (including specification section number).
2. Complete description of proposed substitute, including technical data comprised of drawings, actual dimensions, complete performance specifications, test results and sample (where applicable).
3. Any additional information or data necessary for the Architect to make a complete comparative evaluation.
4. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitute would require.

The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final. Preliminary approval is given contingent upon bidder/proposer being responsible for any costs that may be necessary to modify the space or facilities needed to accommodate the substituted materials and/or equipment approval.

If the Architect approves any proposed substitution, such approval will be set forth in an Addendum. Bidder shall not rely upon approvals made in any other manner.

ADDENDA

Addenda will be transmitted in electronic format through City Blueprint & Supply Company to all who are registered to view the Bidding Documents.

Addenda shall not be issued within a period of seventy-two (72) hours prior to the advertised time for the opening of bids, excluding Saturdays, Sundays, and any other legal holidays; however, if the necessity arises to issue an addendum modifying plans and specifications within the seventy-two (72) hour period, then the opening of bids shall be extended for at least7 days, but not more than 21 days. Such Addendum will state the time and date for opening of bids.

The Owner shall have the right to extend the bid date by up to twenty-one (21) days through the issuance of an addendum without the requirement of re-advertising. Any such extension shall be made by addendum issued by the Architect.

Each Bidder shall ascertain from the Architect prior to submitting his bid that he has received all addenda issued, and he shall acknowledge their receipt on the Bid Form.

BIDDING PROCEDURES

PREPARATION OF BIDS

Bids shall be submitted on the form contained in the Bidding Documents.

All blanks on the Bid Form shall be legibly completed in a non-erasable medium.

Sums shall be expressed in both words and figures. In the case of discrepancy, the sum written in words shall govern.

Interlineations, alterations and erasures must be initialed by the signer of the Bid.

All Alternates shall be bid. If no change in the Base Bid is required, enter "NO CHANGE". Failure to submit Alternate prices will render the Bid incomplete and shall cause its rejection.

Bidder shall make no additional stipulations on the Bid Form nor qualify his bid in any other manner.

The bid shall include the legal name of Bidder and statement whether Bidder is a sole proprietor, partnership, a corporation, or any other legal entity, and the bid shall be signed by the person or persons legally authorized to bind the Bidder to a Contract. In accordance with LA. R.S. 38:2212(5) (a) (b) (c) whenever the bidder is other than a sole proprietor, evidence of authority shall be required for submission of a bid in the form of a corporate resolution, certification as to the corporate principal, or other documents that are acceptable to the public entity. Bidder shall include a corporate resolution with bid submission.

The authority of the signature of the person submitting the bid shall be deemed sufficient and acceptable if the signature on bid is that of authorized representative of corporation, partnership, or other legal entity and bid is accompanied by corporate resolution, certification as to the corporate principal, or other documents indicating authority.

Contractor shall certify that he is licensed under R.S. 37:2150-2163 and show his license number on the bid above his signature or his duly authorized representative.

All signatures shall be in longhand.

SUBMISSION OF BIDS

Bid shall be submitted in a securely sealed opaque envelope and will be received until the time specified and at the place specified in the Advertisement For Bids, or as extended by appropriately issued Addendum. Envelope shall be clearly marked with the following:

- Complete name and address of Bidder.
- Complete project name, location and number, with indication of "BID ENCLOSED".
- The Louisiana Contractor's license number of the Bidder.
- Addressed to the party identified in the Advertisement For Bids as the recipient of all Bids.

It shall be the specific responsibility of each Bidder to deliver its sealed bid at the appointed place not later than the announced time for the receipt and opening of Bids. Late delivery of a Bid for any reason shall disqualify the Bid.

Each bid shall be either hand delivered by the bidder or his agent, in which instance the deliverer shall be given a written receipt, or such bid shall be sent by registered or certified mail with a return receipt requested. The Owner will not accept or take any bid, including receiving hand-delivered bids, on days that are recognized as holidays by the U.S. Postal Service.

If the bid is sent by mail, the sealed bid envelope shall be enclosed in a separate mailing envelope with the notation “Sealed Bid Enclosed” on the face thereof. Other methods of delivery will be rejected.

Bids shall be deposited at the designated location not later than the time on the date for receipt of bids indicated in the Advertisement For Bids, or any extension thereof made by Addendum. Bids received after the time and date for receipt of bids will be returned unopened.

Oral, telephonic, or telegraphic bids are invalid and shall not receive consideration. Owner shall not consider notations written outside of bid envelope that have the effect of amending the bid. Written modifications enclosed in the bid envelope, and signed or initialed by the Contractor or his representative, shall be accepted.

Bidders holding Bidding Documents who are unable to bid shall notify the Owner and Architect of their intent not to bid at least seven (7) calendar days prior to the date of bid receipt and shall return Bidding Documents prior to bid opening.

MODIFICATION OR WITHDRAWAL OF BID

A Bid may not be modified, withdrawn or canceled by the Bidder, except in accordance with R.S. 38:2214 which states in part, "Bids containing patently obvious mechanical, clerical or mathematical errors may be withdrawn by the Contractor if clear and convincing sworn, written evidence of such errors is furnished to the public entity within forty-eight hours of the Bid Opening excluding Saturdays, Sundays and legal holidays".

CONSIDERATION OF BIDS

OPENING OF BIDS

The properly identified Bids received on time will be opened publicly and will be read aloud, and a tabulation abstract of the amounts of the base bids and alternates, if any, will be made available to Bidders.

POST BID INFORMATION

The apparent low bidder(s) as determined by the Architect and/or Owner and so notified, no later than end of business on the first full working day following the bid opening shall submit to the Architect and/or Owner the following no later than 4:00 P.M. on the second full working day following the bid opening:

1. Each bidder on this project must submit the completed Attestation Affidavit (in accordance with LA R.S. 38:2227, 38:2212.10, 23: 1726(B) and the completed Verification Legal Citizen Affidavit forms found within this bid package. The Attestation Affidavit form and the Verification Legal Citizen Affidavit shall be RECEIVED by the Owner. The Attestation Affidavit form and the Verification Legal Citizen Affidavit form are NOT to be included with the bid form and are to be submitted separately. The submission should be identified with the name of the bidder, the project on which he is bidding, and the words ATTESTATION AFFIDAVIT / VERIFICATION LEGAL CITIZEN AFFIDAVIT. Forms may be sent via US Mail, express mail, or hand delivered to Terrebonne General Health System, Facility Management Department – 3rd Floor, 8166 Main Street, Houma, Louisiana 70360, Attention: Mr. Mark Hebert.
2. A complete list of all subcontractors, suppliers, equipment vendors, etc. who will provide materials or services on the project (name, address and phone number).
3. A statement of cost of all items to be accomplished by each proposed subcontractor, supplier, equipment vendor, etc.
4. A designation of the work to be performed by the Bidder with his own forces.
5. A cost breakdown of total contract amount based on line item descriptions listed in project specifications (i.e. Divisions and Sections).
6. Additional information as may be requested by the Architect to allow for the proper evaluation of the cost information provided.
7. Resume of Bidder's proposed project manager, superintendent and key project personnel.

Failure of the Bidder to provide the complete above enumerated information in the time frame indicated will be cause to reject said bid; or the assessment of liquidated damages in the amount of **Three Hundred Dollars ($300.00)** per diem, for each day delay until said information is provided, at the Owner's option. Incomplete information submitted will not be considered as compliant with this contract provision.

The bidder will be required to establish to the satisfaction of the Architect and Owner, the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

The Contractor is totally responsible for any lost time or extra expense incurred due to a Subcontractor's/or Material Supplier's failure to perform. Failure to perform includes a Subcontractor's financial failure, abandonment of the project, or failure to do work up to standard. Under no circumstances shall the Owner mitigate the Contractor's losses or reimburse the Contractor for losses caused by these events.

REJECTIONS OF BIDS

The Owner shall have the right to reject any or all Bids and in particular to reject a Bid not accompanied by any required bid security or data required by the Bidding Documents (including submission of Post Bid Information outlined herein) or a Bid in any way incomplete or irregular.

ACCEPTANCE OF BID

It is the intent of the Owner to award a Contract to the lowest responsible and responsive Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents as advertised and does not exceed the funds available for construction.

It is the intent of the Owner, if he accepts any alternates, to accept them in the order in which they are listed on the Bid Form. Determination of the Low Bidder shall be on the basis of the sum of the Base Bid and the Alternates accepted. However, the Owner shall reserve the right to accept Alternates in any order which does not affect determination of the Low Bidder.

PERFORMANCE AND PAYMENT BOND

BOND REQUIRED

The Contractor shall furnish and pay for a Performance and Payment Bond written by a company licensed to do business in Louisiana, which shall be signed by the surety's agent or attorney-in-fact and countersigned by a person who is under Contract with the surety as a licensed agent in this State and who is residing in this State, in an amount equal to 100% of the Contract amount. Surety must be listed currently on the U.S. Department of Treasury Financial Management Service List (Treasury List) as approved for an amount equal to or greater than the contract amount, or must be an insurance company domiciled in Louisiana or owned by Louisiana residents. If surety is qualified other than by listing on the Treasury list, the contract amount may not exceed fifteen percent of policyholders' surplus as shown by surety's most recent financial statements filed with the Louisiana Department of Insurance and may not exceed the amount of $500,000.00. However, a Louisiana domiciled insurance company with at least an A- rating in the latest printing of the A.M. Best's Key Rating Guide shall not be subject to the $500,000.00 limitation, provided that the contract amount does not exceed ten percent of policyholders' surplus as shown in the latest A.M. Best's Key Rating Guide nor fifteen percent of policyholders' surplus as shown by surety's most recent financial statements filed with the Louisiana Department of Insurance. The Bond shall be signed by the surety's agent or attorney-in-fact and countersigned by a person who is under contract with surety as a licensed agent in Louisiana, and who is residing in Louisiana. The Bond shall be in favor of **Hospital Service District No. 1 - Parish of Terrebonne**.

TIME OF DELIVERY AND FORM OF BOND

The Bidder shall deliver the required bond to the Owner simultaneous with the execution of the Contract.

Bond shall be in the form furnished in the Bidding Documents, AIA Document A312-2010, dated the same day as the Contract.

The Bidder shall require the Attorney-in-Fact who executes the required bond on behalf of the surety to affix thereto a certified and current copy of his Power of Attorney.

FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

Successful bidder will be notified by registered mail of the acceptance of his proposal.

Contract between the Owner and Contractor will be prepared by the Architect and be in a form similar to AIA Document A101-2017 edition.

Contract signing shall be as established by the Owner with proper notice given to the Contractor. A copy of the executed contract and attached bonds shall be filed with the Clerk of Courts, Terrebonne Parish, and the cost shall be paid by the Contractor.

LIQUIDATED DAMAGES

The parties agree that time is of the essence in the completion of this Contract. In the event the Contractor fails to achieve Substantial Completion within the time stipulated in Section 3.3, then Liquidated Damages are hereby stipulated, and shall be assessed against the Contractor, in the amount of **One Thousand Dollars ($1,000.00)** per calendar day after the agreed upon Substantial Completion date that the Work is not fully certified by the Architect as being Substantially Complete and, in such event: (a) the Owner shall be authorized and empowered to recover such Liquidated Damages without placing Contractor in default, the Contractor hereby specifically waiving the necessity of being placed in default as required by Louisiana Civil Code Article 2010; and (b) the Owner shall be, authorized and empowered to recover such Liquidated Damages by deducting and withholding such sum(s), from payments of the Contract Sum to which Contractor would otherwise be entitled hereunder, without further legal process.

The failure on the part of the Contractor to achieve substantial completion within the time provided herein shall, without any further notice or formal placing in default of the Contractor by the Owner, constitute legal default of the Contract on the part of the Contractor and shall, in and of itself, automatically commence the accumulation of liquidated damages in favor of the Owner for which the Contractor shall be held liable. It is the intention of the parties hereto to specifically provide that formal placing in legal default of the Contractor by the Owner is unnecessary, and occurs by the mere expiration of the term provided by this Contract for achieving substantial completion.

The liquidated damages provided for herein are intended to compensate the owner for all financial losses and the additional administrative burden caused by the failure of the Contractor to complete construction timely. Liquidated damages may be due without regard to whether or not the owner actually suffers any financial loss or incurs additional administrative burdens, but, on the contrary, shall be due solely as a result of the failure of the Contractor to complete construction timely.

Criteria for Substantial Completion is as defined in Article 9, subparagraph 9.8 of the General Conditions of the Contract for Construction, as modified by Supplementary General Conditions.

MANDATORY PRE-BID CONFERENCE

A Mandatory pre-bid conference is scheduled to be held as prescribed in the Advertisement For Bids. Attendance at this mandatory pre-bid conference will be documented by a Roster of Attendance and all attendees are required to sign in prior to the scheduled start time and sign out at the end of the conference. All prospective bidders shall be present at the beginning of the pre-bid conference and shall remain in attendance for the duration of the

conference. Any prospective bidder who fails to attend the conference and remain for the duration shall be prohibited from submitting a bid for the project.

The purpose of the Mandatory Pre-Bid Conference is to familiarize Bidders with the requirements of the Project and the intent of the Contract Documents, and to receive comments and information from interested Bidders.

Any revision of the Bidding Documents made as a result of the Pre-Bid Conference shall not be valid unless included in an Addendum issued in accordance with the Instruction to Bidders.

END OF SECTION 00 21 13

R-1020 (4/12)

LDR Contributing to a better quality of life

Designation of Construction Contractor as Agent of a Governmental Entity Sales Tax Exemption Certificate

Hospital Service District No. 1 - Terrebonne Parish, an agency of the United

Legal Name of Governmental Entity

States government, or an agency, board, commission, or instrumentality of the State of Louisiana or its political subdivisions, including parishes, municipalities and school boards, does hereby designate the following contractor as its agent for the purpose of making sales tax exempt purchases on behalf of the governmental body:

Name of Contractor		
Address		
City	State	ZIP

This designation of agency shall be effective for purchases of component construction materials, taxable services and leases and rentals of tangible personal property for the following named construction project:

Construction Project	Contract Number
TGHS Health and Wellness Center	Project #: 21001

This designation and acceptance of agency is effective for the period

Beginning Date *(mm/dd/yyyy)*	End Date *(mm/dd/yyyy)*

Purchases for the named project during this period by the designated contractor shall be considered as the legal equivalent of purchases directly by the governmental body. Any materials purchased by this agent shall immediately, upon the vendor's delivery to the agent, become the property of this government entity. This government entity, as principal, assumes direct liability to the vendor for the payment of any property, services, leases, or rentals made by this designated agent. This agreement does not void or supersede the obligations of any party created under any construction contract related to this project, including specifically any contractual obligation of the construction contractor to submit payment to the vendors of materials or services for the project.

This contractor-agent is not authorized to delegate this purchasing agency to others; separate designations of agency by this governmental entity are required for each contractor or sub-contractor who is to purchase on behalf of this governmental entity. The undersigned hereby certify that this designation is the entirety of the agency designation agreement between them. In order for a purchase for an eligible governmental entity through a designated agent to be eligible for sales tax exemption, the designation of agency must be made, accepted, and disclosed to the vendor before or at the time of the purchase transaction.

Designation of Agency			**Acceptance of Agency**		
Signature of Authorized Designator	Date *(mm/dd/yyyy)*		Signature of Contractor or Subcontractor Authorized Acceptor	Date *(mm/dd/yyyy)*	
Name of Authorized Designator			Name of Contractor's or Subcontractor's Acceptor		
Name of Governmental Entity			Name of Contractor		
Hospital Service District No. 1 - Terrebonne Parish					
Address			Address		
8166 Main Street					
City	State	ZIP	City	State	ZIP
Houma	LA	70360			

This designation of agency form, when properly executed by both the contractor and the governmental entity, shall serve as evidence of the sales tax exempt status that has been conferred onto the contractor. No other exemption certificate form is necessary to claim exemption from sales taxes. The agency agreement evidenced by this sales tax exemption certificate must be implemented at the time of contract execution with the governmental entity. The contract between the governmental entity and his agent must contain provisions to authenticate the conferment of agency.

LOUISIANA UNIFORM PUBLIC WORK BID FORM

TO: Hospital Service District NO.1 - Terrebonne Parish
8166 Main Street
Houma, Louisiana 70360

(Owner to provide name and address of owner)

BID FOR TGHS - Health and Wellness Center
Terrebonne General health System
8166 Main Street
Houma, Louisiana 70360
Architect's Project Number: 21001

(Owner to provide name of project and other identifying information)

The undersigned bidder hereby declares and represents that she/he; a) has carefully examined and understands the Bidding Documents, b) has not received, relied on, or based his bid on any verbal instructions contrary to the Bidding Documents or any addenda, c) has personally inspected and is familiar with the project site, and hereby proposes to provide all labor, materials, tools, appliances and facilities as required to perform, in a workmanlike manner, all work and services for the construction and completion of the referenced project, all in strict accordance with the Bidding Documents prepared by: AQ Studios Architecture and dated: _____

(Owner to provide name of entity preparing bidding documents.)

Bidders must acknowledge all addenda. The Bidder acknowledges receipt of the following **ADDENDA:** (Enter the number the Designer has assigned to each of the addenda that the Bidder is acknowledging) _____.

TOTAL BASE BID: For all work required by the Bidding Documents (including any and all unit prices designated "Base Bid" but not alternates) the sum of:

Refer to Sheet T3-00 for scope of work included in Base Bid. Dollars ($ _____)

ALTERNATES: For any and all work required by the Bidding Documents for Alternates including any and all unit prices designated as alternates in the unit price description.

Alternate No. 1 *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

Refer to Sheet T3-00 for scope of work included in Additive Bid Alternate #1 Dollars ($ _____)

Alternate No. 2 *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

_____ Dollars ($ _____)

Alternate No. 3 *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

_____ Dollars ($ _____)

NAME OF BIDDER: _____

ADDRESS OF BIDDER: _____

_____

LOUISIANA CONTRACTOR'S LICENSE NUMBER: _____

NAME OF AUTHORIZED SIGNATORY OF BIDDER: _____

TITLE OF AUTHORIZED SIGNATORY OF BIDDER: _____

SIGNATURE OF AUTHORIZED SIGNATORY OF BIDDER **: _____

DATE: _____

* N/A

** If someone other than a corporate officer signs for the Bidder/Contractor, a copy of a corporate resolution or other signature authorization shall be required for submission of bid. Failure to include a copy of the appropriate signature authorization, if required, may result in the rejection of the bid unless bidder has complied with La. R.S. 38:2212(A)(1)(c) or RS 38:2212(O) .

BID SECURITY in the form of a bid bond, certified check or cashier's check as prescribed by LA RS 38:2218.A is attached to and made a part of this bid.

TGHS Health and Wellness Center
Terrebonne General Health System

21001

Name of Project **Project No.**

STATE OF _____

PARISH OF _____

ATTESTATIONS AFFIDAVIT

Before me, the undersigned notary public, duly commissioned and qualified in and for the parish and state aforesaid, personally came and appeared Affiant, who after being duly sworn, attested as follows:

LA. R.S. 38:2227 PAST CRIMINAL CONVICTIONS OF BIDDERS

A. No sole proprietor or individual partner, incorporator, director, manager, officer, organizer, or member who has a minimum of a ten percent (10%) ownership in the bidding entity named below has been convicted of, or has entered a plea of guilty or nolo contendere to any of the following state crimes or equivalent federal crimes:

(a) Public bribery (R.S. 14:118)
(b) Corrupt influencing (R.S. 14:120)
(c) Extortion (R.S. 14:66)
(d) Money laundering (R.S. 14:23)

B. Within the past five years from the project bid date, no sole proprietor or individual partner, incorporator, director, manager, officer, organizer, or member who has a minimum of a ten percent (10%) ownership in the bidding entity named below has been convicted of, or has entered a plea of guilty or nolo contendere to any of the following state crimes or equivalent federal crimes, during the solicitation or execution of a contract or bid awarded pursuant to the provisions of Chapter 10 of Title 38 of the Louisiana Revised Statutes:

(a) Theft (R.S. 14:67)
(b) Identity Theft (R.S. 14:67.16)
(c) Theft of a business record (R.S.14:67.20)
(d) False accounting (R.S. 14:70)
(e) Issuing worthless checks (R.S. 14:71)
(f) Bank fraud (R.S. 14:71.1)
(g) Forgery (R.S. 14:72)
(h) Contractors; misapplication of payments (R.S. 14:202)
(i) Malfeasance in office (R.S. 14:134)

LA. R.S. 38:2212.10 Verification of Employees

A. At the time of bidding, Appearer is registered and participates in a status verification system to verify that all new hires in the state of Louisiana are legal citizens of the United States or are legal aliens.

B. If awarded the contract, Appearer shall continue, during the term of the contract, to utilize a status verification system to verify the legal status of all new employees in the state of Louisiana.

C. If awarded the contract, Appearer shall require all subcontractors to submit to it a sworn affidavit verifying compliance with Paragraphs (A) and (B) of this Subsection.

TGHS Health and Wellness Cener
Terrebonne General Health System

	21001
Name of Project	**Project No.**

LA. R.S. 23:1726(B) Certification Regarding Unpaid Workers Compensation Insurance

A. R.S. 23:1726 prohibits any entity against whom an assessment under Part X of Chapter 11 of Title 23 of the Louisiana Revised Statutes of 1950 (Alternative Collection Procedures & Assessments) is in effect, and whose right to appeal that assessment is exhausted, from submitting a bid or proposal for or obtaining any contract pursuant to Chapter 10 of Title 38 of the Louisiana Revised Statutes of 1950 and Chapters 16 and 17 of Title 39 of the Louisiana Revised Statutes of 1950.

B. By signing this bid /proposal, Affiant certifies that no such assessment is in effect against the bidding / proposing entity.

NAME OF BIDDER	**NAME OF AUTHORIZED SIGNATORY OF BIDDER**
DATE	**TITLE OF AUTHORIZED SIGNATORY OF BIDDER**

SIGNATURE OF AUTHORIZED
SIGNATORY OF BIDDER/AFFIANT

Sworn to and subscribed before me by Affiant on the _____ day of _____ , 20___ .

Notary Public

AFFIDAVIT
Verification Legal Citizen

STATE OF _____

PARISH/COUNTY OF _____

BEFORE ME, the undersigned authority, duly commissioned and qualified within and for the state and parish or county aforesaid, personally came and appeared,

_____, representing _____
(name) (company)

_____ who, being by me first duly sworn,
(mailing address)

deposed and said that he or she has read and signed this Affidavit and he/she does hereby attest, under oath, as follows:

(1) That affiant and his or her firm is registered and participates in a status verification system to verify that all employees in the State of Louisiana are legal citizens of the United States or are legal aliens;

(2) That affiant and his or her firm will continue, during the term of the contract with Terrebonne General Health System District No. 1 of the Parish of Terrebonne to utilize a status verification system to verify the legal status of all new employees in the State of Louisiana; and

(3) That affiant and his or her firm will require all subcontractors to submit to them and/or their employer a sworn Affidavit verifying compliance with paragraphs (1) and (2) of this Affidavit.

Prospective bidder or representative to sign **and** type or print name next to signature.

_____
Affiant - Signature Printed Name

SWORN TO AND SUBSCRIBED BEFORE ME ON THIS _____DAY OF _____, **20**___.

_____
NOTARY PUBLIC

STATE OF LOUISIANA, d/b/a TERREBONNE GENERAL

CORPORATE RESOLUTION

EXCERPT FROM MINUTES OF THE BOARD OF DIRECTORS OF _____

_____ , INCORPORATED. At the meeting of directors of _____ , Incorporated, duly noticed and held on _____ 20 _____ , a quorum being there present, on motion duly made and seconded. It was:

RESOLVED That _____ , be and is hereby appointed, constituted and designated as agent and attorney-in-fact of the Corporation with full power and authority to act on behalf of this Corporation in all negotiations, bidding, concerns and transactions with HOSPITAL SERVICE DISTRICT NO. 1 OF THE PARISH OF TERREBONNE, STATE OF LOUISIANA, d/b/a TERREBONNE GENERAL HEALTH SYSTEM or any of its agencies, departments, employees or agents, including but not limited to the execution of all bids, papers, documents, affidavits, bonds, sureties, contracts and acts and to receive and receipt therefore all purchase orders and notices issued pursuant to the provisions of any such bid or contract, this Corporation hereby ratifying, approving, confirming and accepting each and every such act performed by the said agent and attorney-in-fact.

I hereby certify the foregoing to be a true and correct copy of an excerpt of the minutes of the above dated meeting of the Board of Directors of said Corporation, and the same has not been revoked or rescinded.

(Secretary-treasurer)

_____ 20 ___
(Date)

(This form or other document which establishes Evidence of Agency in accordance with LA R.S. 38:2212 et seq. shall be included in Bid Envelope)

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

TGHS Health and Wellness Center
885 Westside Blvd
Houma, LA 70360

THE OWNER:
(Name, legal status and address)

-
Hospital Service District No. 1 – Terrebonne Parish
8166 Main Street
Houma, Louisiana 70360

THE ARCHITECT:
(Name, legal status and address)

AQ Studios Architecture
1100 Poydras Street
Suite 3550
New Orleans, LA 70163

TABLE OF ARTICLES

1 GENERAL PROVISIONS

2 OWNER

3 CONTRACTOR

4 ARCHITECT

5 SUBCONTRACTORS

6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

7 CHANGES IN THE WORK

8 TIME

9 PAYMENTS AND COMPLETION

10 PROTECTION OF PERSONS AND PROPERTY

11 INSURANCE AND BONDS

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

DRAFT

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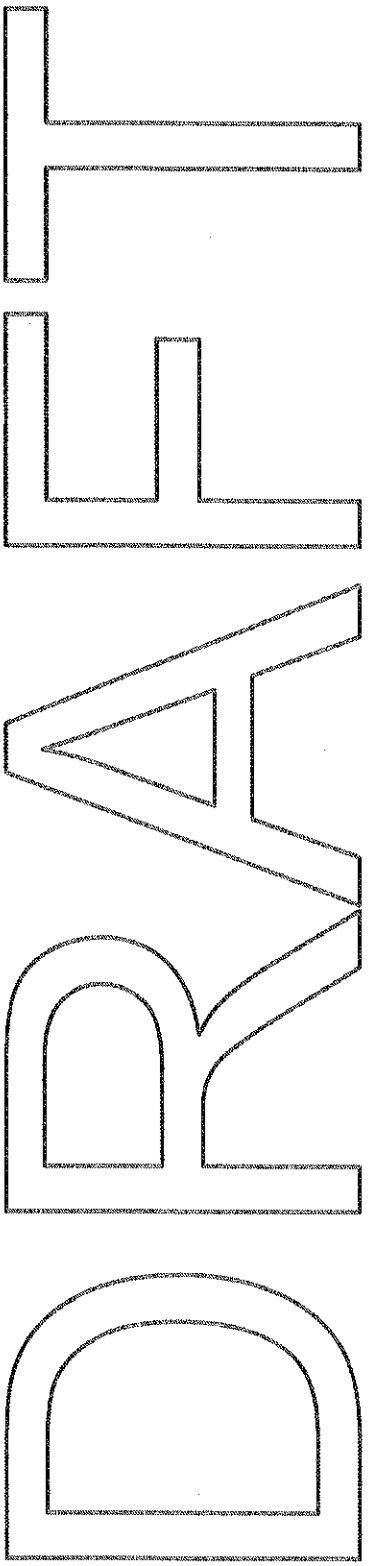
12 UNCOVERING AND CORRECTION OF WORK

13 MISCELLANEOUS PROVISIONS

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES



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INDEX

(Topics and numbers in bold are Section headings.)

Acceptance of Nonconforming Work
9.6.6, 9.9.3, **12.3**
Acceptance of Work
9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3
Access to Work
3.16, 6.2.1, 12.1
Accident Prevention
10
Acts and Omissions
3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5, 10.2.8, 13.3.2, **14.1**, 15.1.2, 15.2
Addenda
1.1.1
Additional Costs, Claims for
3.7.4, 3.7.5, 10.3.2, 15.1.5
Additional Inspections and Testing
9.4.2, 9.8.3, 12.2.1, **13.4**
Additional Time, Claims for
3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.6**
Administration of the Contract
3.1.3, **4.2**, 9.4, 9.5
Advertisement or Invitation to Bid
1.1.1
Aesthetic Effect
4.2.13
Allowances
3.8
Applications for Payment
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.5.4, 9.6.3, ~~9.7,~~ 9.10
Approvals
2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10.1, 4.2.7, 9.3.2, 13.4.1
~~**Arbitration**~~

~~8.3.1, 15.3.2, **15.4**~~
ARCHITECT
4
Architect, Definition of
4.1.1
Architect, Extent of Authority
2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1
Architect, Limitations of Authority and Responsibility
2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2
Architect's Additional Services and Expenses
2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4
Architect's Administration of the Contract
3.1.3, 3.7.4, 15.2, 9.4.1, 9.5
Architect's Approvals
2.5, 3.1.3, 3.5, 3.10.2, 4.2.7
Architect's Authority to Reject Work
3.5, 4.2.6, 12.1.2, 12.2.1
Architect's Copyright
1.1.7, 1.5
Architect's Decisions
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1, 13.4.2, 15.2
Architect's Inspections
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4
Architect's Instructions
3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2
Architect's Interpretations
4.2.11, 4.2.12
Architect's Project Representative
4.2.10
Architect's Relationship with Contractor
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2
Architect's Relationship with Subcontractors
1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3
Architect's Representations
9.4.2, 9.5.1, 9.10.1
Architect's Site Visits
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Asbestos
10.3.1
Attorneys' Fees
3.18.1, 9.6.8, 9.10.2, 10.3.3
Award of Separate Contracts
6.1.1, 6.1.2
Award of Subcontracts and Other Contracts for Portions of the Work
5.2
Basic Definitions
1.1
Bidding Requirements
1.1.1
Binding Dispute Resolution
8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5, 15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1
Bonds, Lien
7.3.4.4, 9.6.8, 9.10.2, 9.10.3
Bonds, Performance, and Payment
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**, 11.1.3, **11.5**
Building Information Models Use and Reliance
1.8
Building Permit
3.7.1
Capitalization
1.3
Certificate of Substantial Completion
9.8.3, 9.8.4, 9.8.5
Certificates for Payment
4.2.1, 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4

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Certificates of Inspection, Testing or Approval
13.4.4
Certificates of Insurance
9.10.2
Change Orders
1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2
Change Orders, Definition of
7.2.1
CHANGES IN THE WORK
2.2.2, 3.11, 4.2.8, **7**, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5
Claims, Definition of
15.1.1
Claims, Notice of
1.6.2, 15.1.3
CLAIMS AND DISPUTES
3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4
Claims and Timely Assertion of Claims
15.4.1
Claims for Additional Cost
3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**
Claims for Additional Time
3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**
Concealed or Unknown Conditions, Claims for
3.7.4
Claims for Damages
3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7
Claims Subject to Arbitration
15.4.1
Cleaning Up
3.15, 6.3
Commencement of the Work, Conditions Relating to
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**
Commencement of the Work, Definition of
8.1.2
Communications
3.9.1, **4.2.4**
Completion, Conditions Relating to
3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2
COMPLETION, PAYMENTS AND
9
Completion, Substantial
3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2
Compliance with Laws
2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3
Concealed or Unknown Conditions
3.7.4, 4.2.8, 8.3.1, 10.3
Conditions of the Contract
1.1.1, 6.1.1, 6.1.4
Consent, Written
3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2
Consolidation or Joinder
15.4.4
CONSTRUCTION BY OWNER OR BY
SEPARATE CONTRACTORS
1.1.4, **6**
Construction Change Directive, Definition of
7.3.1
Construction Change Directives
1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1
Construction Schedules, Contractor's
3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Contingent Assignment of Subcontracts
5.4, 14.2.2.2
Continuing Contract Performance
15.1.4
Contract, Definition of
1.1.2
CONTRACT, TERMINATION OR
SUSPENSION OF THE
5.4.1.1, 5.4.2, 11.5, **14**
Contract Administration
3.1.3, 4, 9.4, 9.5
Contract Award and Execution, Conditions Relating to
3.7.1, 3.10, 5.2, 6.1
Contract Documents, Copies Furnished and Use of
1.5.2, 2.3.6, 5.3
Contract Documents, Definition of
1.1.1
Contract Sum
2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, **9.1**, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5**, **15.2.5**
Contract Sum, Definition of
9.1
Contract Time
1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7.3.7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5
Contract Time, Definition of
8.1.1
CONTRACTOR
3
Contractor, Definition of
3.1, 6.1.2
Contractor's Construction and Submittal
Schedules
3.10, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2
Contractor's Employees
2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.3, 14.1, 14.2.1.1
Contractor's Liability Insurance
11.1

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Contractor's Relationship with Separate Contractors and Owner's Forces
3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4
Contractor's Relationship with Subcontractors
1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4
Contractor's Relationship with the Architect
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1
Contractor's Representations
3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2
Contractor's Responsibility for Those Performing the Work
3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8
Contractor's Review of Contract Documents
3.2
Contractor's Right to Stop the Work
2.2.2, 9.7
Contractor's Right to Terminate the Contract
14.1
Contractor's Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3
Contractor's Superintendent
3.9, 10.2.6
Contractor's Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4
Coordination and Correlation
1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1
Copies Furnished of Drawings and Specifications
1.5, 2.3.6, 3.11
Copyrights
1.5, **3.17**
Correction of Work
2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3, 15.1.3.1, 15.1.3.2, 15.2.1
Correlation and Intent of the Contract Documents
1.2
Cost, Definition of
7.3.4
Costs
2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14
Cutting and Patching
3.14, 6.2.5
Damage to Construction of Owner or Separate Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7
Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2
Date of Commencement of the Work, Definition of
8.1.2
Date of Substantial Completion, Definition of
8.1.3
Day, Definition of
8.1.4
Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1, 15.2
Decisions to Withhold Certification
9.4.1, **9.5**, 9.7, 14.1.1.3
Defective or Nonconforming Work, Acceptance, Rejection and Correction of
2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1
Definitions
1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1
Delays and Extensions of Time
3.2, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**, 10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5
Digital Data Use and Transmission
1.7
Disputes
6.3, 7.3.9, 15.1, 15.2
Documents and Samples at the Site
3.11
Drawings, Definition of
1.1.5
Drawings and Specifications, Use and Ownership of
3.11
Effective Date of Insurance
8.2.2
Emergencies
10.4, 14.1.1.2, **15.1.5**
Employees, Contractor's
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1
Equipment, Labor, or Materials
1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Execution and Progress of the Work
1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4
Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2, 10.4, 14.3, 15.1.6, **15.2.5**
Failure of Payment
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Faulty Work
(See Defective or Nonconforming Work)
Final Completion and Final Payment
4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3

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Financial Arrangements, Owner's
2.2.1, 13.2.2, 14.1.1.4
GENERAL PROVISIONS
1
Governing Law
13.1
Guarantees (See Warranty)
Hazardous Materials and Substances
10.2.4, **10.3**
Identification of Subcontractors and Suppliers
5.2.1
Indemnification
3.17, **3.18**, 9.6.8, 9.10.2, 10.3.3, 11.3
Information and Services Required of the Owner
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5, 9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
Initial Decision
15.2
Initial Decision Maker, Definition of
1.1.8
Initial Decision Maker, Decisions
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Initial Decision Maker, Extent of Authority
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Injury or Damage to Person or Property
10.2.8, 10.4
Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 12.2.1, 13.4
Instructions to Bidders
1.1.1
Instructions to the Contractor
3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2
Instruments of Service, Definition of
1.1.7
Insurance
6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5, **11**
Insurance, Notice of Cancellation or Expiration
11.1.4, 11.2.3
Insurance, Contractor's Liability
11.1
Insurance, Effective Date of
8.2.2, 14.4.2
Insurance, Owner's Liability
11.2
Insurance, Property
10.2.5, 11.2, 11.4, 11.5
Insurance, Stored Materials
9.3.2
INSURANCE AND BONDS
11
Insurance Companies, Consent to Partial Occupancy
9.9.1
Insured loss, Adjustment and Settlement of
11.5
Intent of the Contract Documents
1.2.1, 4.2.7, 4.2.12, 4.2.13
Interest
13.5
Interpretation
1.1.8, 1.2.3, **1.4**, 4.1.1, 5.1, 6.1.2, 15.1.1
Interpretations, Written
4.2.11, 4.2.12
Judgment on Final Award
15.4.2
Labor and Materials, Equipment
1.1.3, 1.1.6, **3.4**, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Labor Disputes
8.3.1
Laws and Regulations
1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Liens
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Limitations, Statutes of
12.2.5, 15.1.2, 15.4.1.1
Limitations of Liability
3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6, 4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3, 11.3, 12.2.5, 13.3.1
Limitations of Time
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7, 5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15, 15.1.2, 15.1.3, 15.1.5
Materials, Hazardous
10.2.4, **10.3**
Materials, Labor, Equipment and
1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
Means, Methods, Techniques, Sequences and Procedures of Construction
3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2
Mechanic's Lien
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Mediation
8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1, 15.4.1.1
Minor Changes in the Work
1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, **7.4**
MISCELLANEOUS PROVISIONS
13
Modifications, Definition of
1.1.1
Modifications to the Contract
1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2
Mutual Responsibility
6.2
Nonconforming Work, Acceptance of

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9.6.6, 9.9.3, **12.3**
Nonconforming Work, Rejection and Correction of
2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2
Notice
1.6, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4, 3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4, 8.2.2 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1, 13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5, 15.1.6, 15.4.1
Notice of Cancellation or Expiration of Insurance
11.1.4, 11.2.3
Notice of Claims
1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5, 15.1.6, 15.2.8, 15.3.2, 15.4.1
Notice of Testing and Inspections
13.4.1, 13.4.2
Observations, Contractor's
3.2, 3.7.4
Occupancy
2.3.1, 9.6.6, 9.8
Orders, Written
1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2, 14.3.1
OWNER
2
Owner, Definition of
2.1.1
Owner, Evidence of Financial Arrangements
2.2, 13.2.2, 14.1.1.4
Owner, Information and Services Required of the
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
Owner's Authority
1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7
Owner's Insurance
11.2
Owner's Relationship with Subcontractors
1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2
Owner's Right to Carry Out the Work
2.5, 14.2.2
Owner's Right to Clean Up
6.3
Owner's Right to Perform Construction and to Award Separate Contracts
6.1
Owner's Right to Stop the Work
2.4
Owner's Right to Suspend the Work
14.3
Owner's Right to Terminate the Contract
14.2, 14.4
Ownership and Use of Drawings, Specifications and Other Instruments of Service
1.1.1, 1.1.6, 1.1.7, **1.5**, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12, 5.3
Partial Occupancy or Use
9.6.6, **9.9**
Patching, Cutting and
3.14, 6.2.5
Patents
3.17
Payment, Applications for
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3
Payment, Certificates for
4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4
Payment, Failure of
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Payment, Final
4.2.1, 4.2.9, **9.10**, 12.3, 14.2.4, 14.4.3
Payment Bond, Performance Bond and
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
Payments, Progress
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
PAYMENTS AND COMPLETION
9
Payments to Subcontractors
5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2
PCB
10.3.1
Performance Bond and Payment Bond
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
Permits, Fees, Notices and Compliance with Laws
2.3.1, **3.7**, 3.13, 7.3.4.4, 10.2.2
PERSONS AND PROPERTY, PROTECTION OF
10
Polychlorinated Biphenyl
10.3.1
Product Data, Definition of
3.12.2
Product Data and Samples, Shop Drawings
3.11, **3.12**, 4.2.7
Progress and Completion
4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.4
Progress Payments
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
Project, Definition of
1.1.4
Project Representatives
4.2.10
Property Insurance
10.2.5, **11.2**
Proposal Requirements
1.1.1
PROTECTION OF PERSONS AND PROPERTY
10
Regulations and Laws

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1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Rejection of Work
4.2.6, 12.2.1
Releases and Waivers of Liens
9.3.1, 9.10.2
Representations
3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1
Representatives
2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1
Responsibility for Those Performing the Work
3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10
Retainage
9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3
Review of Contract Documents and Field Conditions by Contractor
3.2, 3.12.7, 6.1.3
Review of Contractor's Submittals by Owner and Architect
3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2
Review of Shop Drawings, Product Data and Samples by Contractor
3.12
Rights and Remedies
1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1, 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2, 12.2.4, **13.3**, 14, 15.4
Royalties, Patents and Copyrights
3.17
Rules and Notices for Arbitration
15.4.1
Safety of Persons and Property
10.2, 10.4
Safety Precautions and Programs
3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4
Samples, Definition of
3.12.3
Samples, Shop Drawings, Product Data and
3.11, **3.12**, 4.2.7
Samples at the Site, Documents and
3.11
Schedule of Values
9.2, 9.3.1
Schedules, Construction
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Separate Contracts and Contractors
1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2
Separate Contractors, Definition of
6.1.1
Shop Drawings, Definition of
3.12.1
Shop Drawings, Product Data and Samples
3.11, **3.12**, 4.2.7
Site, Use of
3.13, 6.1.1, 6.2.1
Site Inspections
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4
Site Visits, Architect's
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Special Inspections and Testing
4.2.6, 12.2.1, 13.4
Specifications, Definition of
1.1.6
Specifications
1.1.1, **1.1.6**, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
Statute of Limitations
15.1.2, 15.4.1.1
Stopping the Work
2.2.2, 2.4, 9.7, 10.3, 14.1
Stored Materials
6.2.1, 9.3.2, 10.2.1.2, 10.2.4
Subcontractor, Definition of
5.1.1
SUBCONTRACTORS
5
Subcontractors, Work by
1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7
Subcontractual Relations
5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1
Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3
Submittal Schedule
3.10.2, 3.12.5, 4.2.7
Subrogation, Waivers of
6.1.1, **11.3**
Substances, Hazardous
10.3
Substantial Completion
4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 15.1.2
Substantial Completion, Definition of
9.8.1
Substitution of Subcontractors
5.2.3, 5.2.4
Substitution of Architect
2.3.3
Substitutions of Materials
3.4.2, 3.5, 7.3.8
Sub-subcontractor, Definition of
5.1.2
Subsurface Conditions
3.7.4
Successors and Assigns
13.2
Superintendent
3.9, 10.2.6
Supervision and Construction Procedures
1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4
Suppliers
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6, 9.10.5, 14.2.1
Surety

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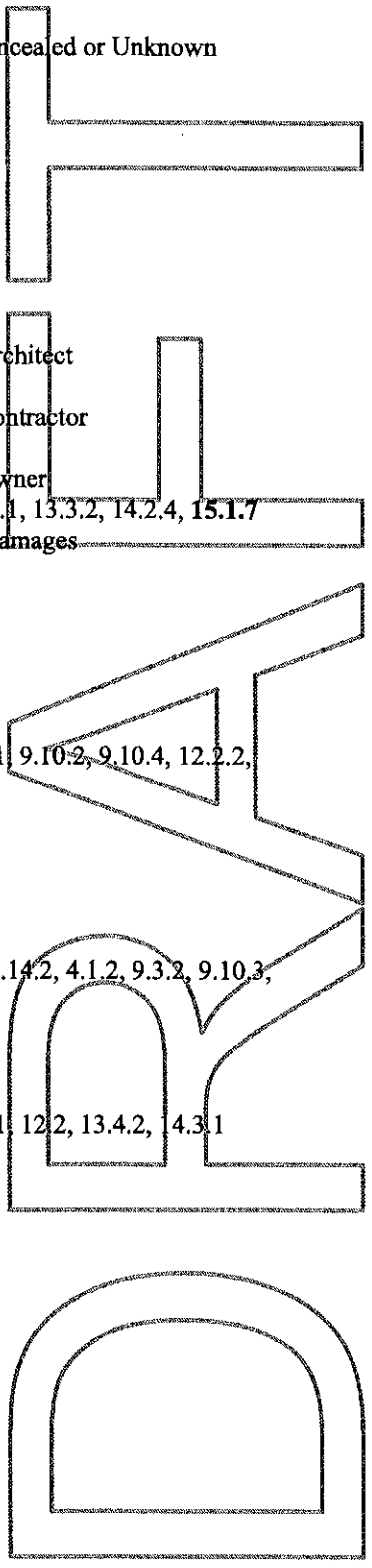
5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2, 15.2.7
Surety, Consent of
9.8.5, 9.10.2, 9.10.3
Surveys
1.1.7, 2.3.4
Suspension by the Owner for Convenience
14.3
Suspension of the Work
3.7.5, 5.4.2, 14.3
Suspension or Termination of the Contract
5.4.1.1, 14
Taxes
3.6, 3.8.2.1, 7.3.4.4
Termination by the Contractor
14.1, 15.1.7
Termination by the Owner for Cause
5.4.1.1, **14.2**, 15.1.7
Termination by the Owner for Convenience
14.4
Termination of the Architect
2.3.3
Termination of the Contractor Employment
14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT
14
Tests and Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 12.2.1, **13.4**
TIME
8
Time, Delays and Extensions of
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5
Time Limits
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2, 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15.1.2, 15.1.3, 15.4
Time Limits on Claims
3.7.4, 10.2.8, 15.1.2, 15.1.3
Title to Work
9.3.2, 9.3.3
UNCOVERING AND CORRECTION OF WORK
12
Uncovering of Work
12.1
Unforeseen Conditions, Concealed or Unknown
3.7.4, 8.3.1, 10.3
Unit Prices
7.3.3.2, 9.1.2
Use of Documents
1.1.1, 1.5, 2.3.6, 3.12.6, 5.3
Use of Site
3.13, 6.1.1, 6.2.1
Values, Schedule of
9.2, 9.3.1
Waiver of Claims by the Architect
13.3.2
Waiver of Claims by the Contractor
9.10.5, 13.3.2, **15.1.7**
Waiver of Claims by the Owner
9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, **15.1.7**
Waiver of Consequential Damages
14.2.4, 15.1.7
Waiver of Liens
9.3, 9.10.2, 9.10.4
Waivers of Subrogation
6.1.1, **11.3**
Warranty
3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2, 15.1.2
Weather Delays
8.3, 15.1.6.2
Work, Definition of
1.1.3
Written Consent
1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3, 13.2, 13.3.2, 15.4.4.2
Written Interpretations
4.2.11, 4.2.12
Written Orders
1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1



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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. ~~Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.~~ The Contract Documents shall include Bidding Documents as listed in the Instructions to Bidders and any modifications made thereto by Addenda.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

1.2.1.2 In the event of conflicts or discrepancies among the Contract Documents, Interpretation will be based on the following priorities:

1. The Agreement.
2. Addenda, with those of later date having precedence over those of earlier date.
3. The General Conditions of the Contract for Construction.
4. Drawings and Specifications.

1.2.1.3. In the case of inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architect's interpretation.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

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§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental

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entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 ~~Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner~~ The Contractors shall secure and pay for necessary permits, approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have

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express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

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§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them. Proper clothing and conduct by workers is required at all times. Working without shirts is not permitted. There shall be no association of workers with patients or medical staff, tobacco usage is not allowed on Terrebonne General properties, no use of or possession of drugs, fire arms, explosives and alcohol on the construction site. Identification tags will be issued by the Contractor for all individual workers on the project. These must be worn at all times. Workers without I.D. tags are not permitted on the site.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4. The Contractor shall submit to the Architect the project warranty for the entire Work and special warranty-guarantees required by the specifications, on his letterhead excluding specified manufacturer's guarantees/warranties. Submittal of all warranties and guarantees is required as prerequisite of the final payment.

§ 3.6 Taxes

The Contractor shall ~~pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.~~not pay any state or local sales, or state or local use taxes on materials or equipment which are affixed and made a part of the real estate of the project or work in which is permanently incorporated into the project or work (hereinafter referred to as "applicable materials or equipment"). All purchases of applicable materials or equipment shall be made by the contractor on behalf of and as the agent of Hospital Service District No. 1, of the Parish of Terrebonne, a political subdivision of the State of Louisiana. No state or local sales or use taxes are owed on applicable materials or equipment under the provisions of Louisiana Revised Statue 47:301(8)(c). Owner will furnish contractor a certificate on a form R-1020 supplied by the Louisiana Department of Revenue and Taxation which certified that owner is not required to pay such state or local sales or use taxes and contractor shall furnish a copy of such certificates to all vendors or suppliers of the applicable materials or equipment. The owner agrees to indemnify contractor against the payment of any state or local sales or use taxes which are required to be paid regarding the work or the project or any materials or equipment supplied or purchased by the contractor for the work under the contract. Any applicable materials or equipment purchased by the agent through the use of this certificate immediately become the property of Hospital Service District No. 1, of the Parish of Terrebonne, upon delivery to the contractor/agent.

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§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

~~**§ 3.8 Allowances**~~

~~**§ 3.8.1** The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.~~

~~**§ 3.8.2** Unless otherwise provided in the Contract Documents,~~

- ~~.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;~~
- ~~.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and~~
- ~~.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.~~

~~**§ 3.8.3** Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.~~

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3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals.

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Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

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3.12.11 Shop Drawings, Product Data, or Samples that contain excessive errors, or that are incomplete will be rejected and any delay caused thereby will be the responsibility of the Contractor.

3.12.12 More than two reviews of the same submittal by the Architect necessitated by continuing errors and deficiencies will result in additional costs to the Owner. Contractor agrees to reimburse the Owner through deductive Change Order to the Contract for all costs associated with such reviews.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

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§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

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§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives. There shall be no restrictions on the Owner having a project representative.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

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§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 ~~Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect~~ Within 10 days of bid opening, excluding weekends and holidays, the Contractor shall furnish in writing to the Owner and Architect the names of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. ~~The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.~~ The Contractor shall be solely responsible for selection and performance of all subcontractors. The Contractor shall not be entitled to claims for additional time and/or an increase in the contract sum due to problems with performance or non-performance of a subcontractor.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum ~~and Contract Time~~ shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum ~~or Contract Time~~ shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required. The Contractor shall notify the Owner and Architect if a subcontractor is proposed to be changed and substituted- with another subcontractor for cause. Subcontractor substitution shall be with the Owner and Architect's approval only.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

~~**§ 5.4 Contingent Assignment of Subcontracts**~~

~~**§ 5.4.1** Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that~~

~~.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and~~

~~.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.~~

~~When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.~~

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~~§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.~~

~~§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.~~

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

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§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written ~~instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of~~ order to the Contractor signed by the Owner and the Architect, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Sum or Contract Time. The Contract Sum and The Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therewith including the adjustment in the Contract Sum or the Contract Time.

§ 7.2.2 The Cost to the owner resulting in a change in the Work shall be a sum of:
.1 Contractor's material and labor cost
.2 Subcontractor's and/or Sub-Subcontractor's (as defined in Article 5) material and labor cost.
.3 Overhead and Profit.

7.2.3 The ~~change in the Work;~~credit to the Owner resulting from a change in the Work shall be the sum of:
.1 Contractor's material and labor cost.
.2 Subcontractor's and/or Sub-Subcontractor's material and labor cost
.3 Credit will not be required for overhead and profit.

7.2.4 The Contractor will be due Extended Overhead for time delays only
when complete stoppage of work occurs causing a contract completion extension, the stoppage must be due to acts or omissions solely attributable to the Owner. In all cases, the Contractor is to notify the Architect in writing as required by Article 15.

7.2.5 Before a Change Order is prepared the Contractor shall provide and deliver to the Architect the following information, not subject to waiver, within a reasonable time after being notified to prepare said Change Order:
.1 An itemized list of material and labor cost for the General Contractor's work including quantities and unit costs for each item of labor and each item of material.
.2 An itemized list of material and labor costs for each subcontractor's and/or Sub-Subcontractor's work including quantities and unit costs for each item of labor and each item of material.

7.2.6 Overhead and profit shall be computed by one of the following methods but shall not exceed a total of 25% on any portion of Work.
~~Contract Sum;~~ .1 When all the Work is General Contract Work: 15% of the cost of the Work for overhead and profit.
.2 When the Work is all Subcontract Work: 15% of the cost of the Work for subcontractor's overhead and profit plus 10% of the cost of the Work, not including the Subcontractor's overhead and profit, for General Contractor's overhead and profit.

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.3 ~~The extent~~ When the Work is a combination of General Contract Work and Subcontract Work: the portion of the Cost that is General Contract Work shall be figured per 7.2.6.1 and that portion of the cost that is Subcontract Work shall be calculated per 7.2.6.2

7.2.7 After a Change Order has been approved, no follow-on request for extensions of time or additional cost shall be considered for the Work included in the Change Order.

7.2.8 Cost of the Work for the purpose of Change Orders shall be costs necessarily incurred in performance of the Work and paid by the Contractor which shall consist of:
.1 Wages paid.
.2 Cost of all materials and supplies
.3 Cost of necessary machinery and equipment.
.4 Cost of insurance, fringe, benefits, unemployment compensating, social security, bond premiums, and any other documents costs.

7.2.9 Subcontract cost shall consist of the items in 7.2.8 above plus overhead and profit as defined in 7.2.6.

7.2.10 Cost of the Work whether General Contract cost or Subcontract cost shall not apply to the following:
.1 Salaries or other compensation of the Contractor's personnel at the Contractor's principal office and branch offices.
.2 Any part of the Contractor's capital expenses, including interest on the Contractor's capital employed for the Work.
.3 Overhead and general expenses of any kind or the cost of any item not specifically and expressly included above in cost of the Work.
.4 Cost of supervision not specifically required by the Change Order.
.5 Cost due to the negligence of the Contractor, any Subcontractor or Sub-Subcontractor, anyone directly employed by any of them, or for whose acts any of them may be liable, including but not limited to the correction of defective or nonconforming work, disposal of materials and equipment wrongly supplied, making good any damage to property or delays caused by failure to provide adequate Change Order documentation.

7.2.11 When applicable as provided by the Contract, the cost to Owner for Change Orders shall be determined by quantities and unit prices. The quantity of any item shall be as submitted by the Contractor and approved by the Architect. Unit shall cover cost of Material, Labor, Equipment, Overhead and Profit.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.4.

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§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds ~~and insurance, permit fees, and sales, use, or similar taxes, directly~~ and insurance and permit fees related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

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ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. ~~By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.~~ Completion of the Work must be within the Time for Completion stated in the Agreement, subject to such extension as may be granted under Section 8.3. The Contractor agrees to commence Work not later than ten (10) days following the date prescribed in the Owner/Contractor Agreement and to substantially complete the project within the time stated in the Contract. The Owner will suffer financial loss if the project is not substantially complete in the time set forth in the Contract Documents. The Contractor and the Contractor's Surety shall be liable for and shall pay to the Owner the sum stated in the Contract Documents as fixed, agreed and liquidated damages for each consecutive calendar (Saturdays, Sundays, and holidays included) of delay until the Work is substantially complete. The Owner shall be entitled to the sum stated in the Contract Documents. Such Liquidated Damages shall be withheld by the Owner from the amounts due the Contractor for progress payments and/or retainage payments.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence the Work on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending ~~mediation and binding dispute resolution; or~~ litigation; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may ~~determine.~~recommend, subject to Owner's approval by Change Order. If the claim is not made within the limits of Article 15, all rights for future claims for that month are waived.

8.3.1.1 Normal adverse weather according to the following table, which is based on National Oceanic and Atmospheric Administration records, shall not be cause for an extension of Contract time unless such extension is agreed to in writing between Contractor and Owner.

MONTHLY NORMAL ADVERSE WATHER (CALENDAR DAYS)

JAN – 11 DAYS	FEB – 9 DAYS	MAR – 7 DAYS	APR – 6 DAYS
MAY – 5 DAYS	JUN – 7 DAYS	JUL – 10 DAYS	AUG – 9 DAYS
SEP – 7 DAYS	OCT – 4 DAYS	NOV – 6 DAYS	DEC – 9 DAYS

8.3.1.2 In planning the construction schedule within the agreed Contract Time, the Contractor shall anticipate days of adverse weather conditions for season or seasons of the year as listed in 8.3.1.1. Only those weather delays which prevent work on critical activities for 50% or more of the Contractor's scheduled work day and which are attributable to other than normal weather conditions will be considered by Architect for extension of time.

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§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

9.2.1 Where the Contract is based on a stipulated sum ~~or Guaranteed Maximum Price~~, the Contractor shall submit ~~a schedule of values to the Architect before the first Application for Payment,~~ in writing and within ten (10) calendar days of bid opening to the Owner, through the Architect, a schedule of values allocating the entire Contract Sum to the various portions of the ~~Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect,~~ Work and prepared in such form and supported by all such data to substantiate its accuracy as the Architect may require. Schedule shall be structured to isolate cost associated with base Bid and additive alternate costs separately.

9.2.2 Schedule of value format shall be as provided for in the Contract Documents for use in Contractor's Monthly Application for Payment as noted in paragraph 9.3 below.

9.2.3 Each line item contained on schedule of values, divided into the CSI division format, including 6 digit section number breakdowns, as outlined in the Project Manual index, shall include labor, material, overhead and profit. Total of all items shall equal the Total Contract Sum.

9.2.4 Once approved by the Architect, schedule shall be utilized as the basis of the Contractor's application for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

The form of Application for Payment shall be AIA Document G702, Application and Certification for Payment supported by AIA Document G703, Continuation Sheet, and a certified and witnessed statement by the Contractor that all Subcontractors, material suppliers or other persons or entities for which payment has been requested in previous payment applications have been paid in full to the filing of the current statement. In the event that the Contractor cannot provide the above certification, the Contractor shall provide a certified and witnessed statement outlining the nonconforming payments and the corresponding amounts. Documents shall be latest edition. The Contractor shall submit application to Architect each month, not less than forty-eight (48) hours prior to monthly coordination meeting excluding weekends and holidays. The Contractor shall submit three (3) originals unless more copies are required by the Owner. The Contractor shall submit payments for the value of labor and materials incorporated into the work and for materials suitably stored at the site less the normal retainage as follows;

Retainage of 10% of the contract price for projects with contract price up to $500,000.

Retainage of 5% of the contract price for projects with contract price of $500,001 or more.

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Upon Substantial Completion, the Owner will pay 90% for contracts up to $500,000 and 95% for contracts $500,001 and over of the amount due the Contractor on account of progress payments less the value of punch list items and unsettled claims. No partial payment of retainage will be made on the basis of partial occupancy, including newly constructed areas.

~~**§ 9.3.1.1** As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.~~

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised

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amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment ~~in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.~~within thirty (30) calendar days.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar ~~manner.~~manner in accordance with Louisiana Revised Statue.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall

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be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

~~**§ 9.7 Failure of Payment**~~

~~If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.~~

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the ~~Work or designated portion thereof~~ total Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The Architect shall determine if the project is substantially complete in accordance with the Subparagraph.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to ~~final payment.~~ occupancy. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

9.8.2.1 A "punch list" of "exceptions" and the dollar value related there-to will be prepared by the Architect from the list submitted by the Contractor. A monetary value will be assigned to this list estimated to represent the actual value of the work. Cost of these items shall be prepared in the same format as the schedule of values. None of these funds shall be due the Contractor until all punch list items are completed and are accepted by the Owner and Architect. If the dollar value of the punch list exceeds the amount of funds, less the retainage amount in the remaining balance of the Contract, then the project shall not be accepted as substantially complete until a sufficient amount of the punch list work has been completed.

9.8.2.2 If all punch list items have not been completed by the end of the forty-five (45) day lien period through no fault of the Architect or Owner, the Owner may hold the Contractor in default. If the Owner finds the Contractor is in default the surety shall be notified. If within thirty (30) days after notification, the Contractor and surety have not taken reasonable steps to complete the punch list, the Owner may, at his option, contract to have the balance of the work completed, and pay for such work with the unpaid funds remaining in the Contract sum.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work ~~or designated portion thereof is substantially complete.~~ is substantially complete. Prior to the inspection by the Architect, the Contractor shall notify the Architect that the project is ready for inspection by the State Fire Marshal's Office. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work ~~or designated portion thereof~~ for its intended use, the Contractor shall, before ~~issuance of the Certificate of Substantial Completion,~~ acceptance of the work as substantially complete, complete or correct such item upon

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notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work ~~or designated portion thereof~~ is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work ~~or designated portion thereof~~ unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. The Contractor shall record the Certificate of Substantial Completion with the Clerk of Courts Mortgage Records office in the parish in which the work has been done, to commence the forty-five (45) day lien period. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

9.8.6 Upon Substantial Completion of the Work and upon the recommendations of the Architect, the Owner shall accept the work in accordance with the Certificate of Substantial Completion, AIA Document G704, and the provisions, as amended of Louisiana R.S. 9:4802.1. The Owner shall sign the Certificate of Substantial Completion of the Work and the Contractor shall cause the Certificate to be recorded in the mortgage office of the parish in which the work has been done. The Contractor shall notify the Owner and Architect of the number and folio where said certificate is recorded. Issuance of the Certificate of Substantial Completion does not constitute acceptance.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 Partial Occupancy is the stage in the progress of the Work when a designated portion of the Work is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the designated portion of the Work for its intended use. The Owner may occupy or use any ~~completed or partially completed portion of the Work at any stage when such portion is~~ portion of the Work deemed acceptable for Beneficial Occupancy so designated by separate agreement with the ~~Contractor, provided such occupancy or use is consented to by the insurer~~ Contractor and authorized by public authorities having jurisdiction over the Project. Such ~~partial~~ occupancy or use may commence ~~whether or not the portion is substantially complete,~~ provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, ~~retainage, if any,~~ if any security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the ~~Contract~~ Contact Documents. When the Contractor considers ~~a portion substantially~~ the designated portion complete, the Contractor shall prepare and submit a list to the Architect as provided under ~~Section~~ Subparagraph 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. ~~The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.~~

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. If the Architect does not find the work acceptable under the Contract Documents, the Architect shall make one additional inspection. If the work is still not acceptable, the Architect, and each of the

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Architect's principal consultants, shall be paid $165.00/hour for their time at the project site, for each additional inspection to be withheld from the unpaid funds remaining in the Contract sum. The payments shall be made by the Owner and deducted from the amount to be paid to the Contractor. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

9.10.6 In response to Federal Arbitrage regulations: If such compliance has not been effected within 90 calendar days of the date of acceptance, the contract shall be terminated and no further opportunity will be granted the Contractor and no further payments will be made on this contract.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

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.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

~~.4 The General Contractor shall be solely responsible for security and safety of all people and property including the Owner's Fixed and Movable Property within the existing facility during renovation operations when the existing facility is placed in the care of the General Contractor for operations outside of the Owner's normal occupancy periods. Extreme care shall be taken to ensure that the facility is secured at all times and the Owner's property is protected. Work during these periods shall be scheduled with the Owner and shall include pre and post inspections of the area by both the Owner and General Contractor. The General Contractor shall reimburse the Owner for any damaged or missing property during these periods. Security involves keeping the existing buildings locked at all times so that unauthorized individuals cannot enter the facilities.~~

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

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§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), or lead, encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. ~~Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.~~

~~**§ 10.3.3** To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.~~

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

~~**§ 10.3.6** If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.~~

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall ~~act,~~ notify the Owner and Architect immediately of the emergency simultaneously acting at the Contractor's discretion, to prevent ~~threatened~~ damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency work shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

1. § 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurances as will protect the

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Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

.1 **Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;**

.2 **Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;**

.3 **Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;**

.4 **Claims for damages insured by usual personal injury liability coverage;**

.5 **Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;**

.6 **Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;**

.7 **Claims for bodily injury or property damage arising out of completed operations; and**

.8 **Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.**

.9 **Liability Insurance shall include all major divisions of coverage and be on comprehensive basis, including:**

1. Premises & Operations.
2. Independent Contractors Protective covering Contractor's subs, if any.
3. Products and Completed Operations.
4. Personal Injury & Advertising Liability.
5. Blanket Contractual Liability.
6. Auto Liability — Symbol 1 for all owned, non-owned and hired cars.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operation coverage as specified in the Contract Documents.

11.1.2.1 General Liability insurance must be written on an "occurrence" form. Insurance written on a "claims made" form isn not acceptable.

11.1.2.2 The insurance required by subparagraph 11.1.1 shall be written for not less than the following limits, or greater, if required by law;

.1 **Worker's Compensation:** (a) Coverage A – State of Louisiana – Statutory provisions; (b) Coverage B – Employer's Liability: $1,000,000 per Accident, $1,000,000 Disease – Each Employee, $1,000,000 Disease – Annual Aggregate; (c) Applicable federal coverage, e.g. Longshoreman's Railroad Act, Etc.; Statutory Limit

This policy shall be endorsed to include a Waiver of Subrogation in favor of **the Owner**, its officers and employees.

.2 **Commercial General Liability** including Premises & Operations, Independent contractor's Protective Liability and Products and Complete Operations: (a) Bodily Injury & Property Damage Liability combined single limit of: $1,000,000 per Occurrence, $3,000,000 Annual Aggregate: (b) Personal & Advertising Liability combined single limit of: $1,000,000 per Occurrence.

.3 **Owner's Protective Liability** including Bodily Injury and Property Damage Combined Single Limit of Liability of: $1,000,000 per Occurrence.

.4 **Automobile Liability** including Bodily Injury and Property Damage Combined Single Limit of Liability of $1,000,000 per occurrence.

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.5 Umbrella or Excess Liability which applies as excess over and lists as underlying the Worker's Compensation, General Liability and Auto Liability policies specified above with Umbrella limit of: $1,000,000 per Occurrence, $1,000,000 Annual Aggregate.

.6 Aircraft Liability when aircrafts are used in the direct performance of the Contract and shall include Bodily Injury (including passengers) and Property Damage Combined Single Limit of Liability of: $1,000,000 per Occurrence.

.7 Watercraft Liability (Owned & Non-Owned) when watercrafts are used in the direct performance of the Contract for Bodily Injury and Property Damage Combined Single Limit of Liability of $1,000,000 per Occurrence.

.8 Products & Completed Operations included in the Commercial General Liability policy must be continued in force for a period of at least ten (10) years after completion of the total contract.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness. If the insurance is written on the Comprehensive General Liability policy form, the Certificates shall be AIA Document G705, "Certificate of Insurance". If this insurance is written on a Commercial General Liability policy form, ACCORD Form 25S will be acceptable.

§ 11.1.4 The following requirements shall apply to all insurance and bonds required under Article 11:

a. Insurance and bonds provided by the Contractor shall be with a reliable company (having at least "A-, X or above" Financial Rating according to the latest A.M. Best Report) of the Contractor's choice, acceptable to and approved by the Owner and authorized to do business in the state where the project is located.

b. The Contractor shall have the policies endorsed to reflect and insure any occupancy by Owner at the time of such occupancy and shall name the Architect, Architect's consultants, and the Owner as additional insureds.

c. All liability policies referred to in this Article shall be maintained in the same company.

§ 11.1.5 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include ~~as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.~~ (1) the Owner, the Architect and the Architect's Consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 Performance Bond and Payment Bond

§ 11.2.1 The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder. Bonds shall be obtained through a company licensed to do business in the State of Louisiana, and the cost thereof shall be included in the Contract Sum. The amount of each bond shall be equal to 100% percent of the Contract Sum.

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~~§~~ 11.2.2 The Contractor shall deliver the required bonds to the Owner not later than the date Agreement is entered into.

§ 11.2.3 Any bonds issued shall have affixed thereto a certified and current copy of the power of attorney that authorizes the signatory to issue the bond.

§ 11.2.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under ~~the Contract,~~ the Contract,the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.3 ADDITIONAL INSURANCE / BOND REQUIREMENTS

§ 11.3.1 The following requirements shall apply to all insurance and bonds required under Article 11:

.1 Insurance and bonds provided by the Contractor shall be with a reliable company (having at least an "A-, X or above" Financial Rating according to the latest A.M. Best Report) of the Contractor's Choice, acceptable to and approved by the Owner and authorized to do business in the state where the project is located.
.2 The Contractor shall have the policies endorsed to reflect and insure any occupancy by Owner at the time of such occupancy and shall name the Architect, Architect's consultants, and the Owner as additional insureds.
.3 All liability policies referred to in this Article shall be maintained in the same company.

~~**§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.**~~

§ 11.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an ~~impending~~ impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required ~~coverage.~~coverage.

§11.5
~~§ 11.2 Owner's Insurance~~
OWNER'S INSURANCE

~~§ 11.2.1 The Owner shall purchase and maintain insurance~~ The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

~~of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.~~

11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the

~~**§ 11.2.2 Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere~~

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~~in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.~~proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

~~§ 11.2.3 Notice of Cancellation~~ § 11.6 PROPERTY INSURANCE.

~~or Expiration of Owner's Required Property Insurance.~~ ~~Within three (3) business days of the date the Owner becomes aware of an impending~~ **§ 11.6.1** The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is Louisiana.

~~or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum~~ located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project. Builder's Risk insurance, in the amount of the total completed value shall be furnished by the Contractor to cover loss or damage to the work or to construction materials at the worksite, plus architectural and consulting engineering fees. The policy shall cover the interest of the contractor, all sub-contractors and Terrebonne Parish Hospital Service District No. 1. Perils shall be "all risk" with a deductible as determined by the Contract. If insurance underwriting considerations dictate a larger Windstorm deductible, the policy may have split deductibles. The Contractor must bear the deductible in each claim.

§ 11.6.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

~~to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance~~ **§ 11.6.1.2** Contactor's attention is directed to the fact that because of the nature of the Work, the Contractor will have in his care, custody, and control, at various stages of the Work, property of others which may be subject to damage. This situation is set forth here, so that Contractor will take into consideration this exposure and possibility of loss that would not be covered under a General Liability Policy and provide necessary protection for himself as provided in **Paragraph 11.2**

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~~shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.~~ § 11.6.1.3 The Builder's Risk policy shall not be extended to cover transit risks or the tools or equipment of the contractor or sub-contractor. The risk of loss to such property is to fall on the Contractor.

§ ~~11.3~~ 11.7 Waivers of Subrogation

§ ~~11.3.1~~ 11.7.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's ~~consultants;~~ consultants: and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had ~~an~~ a insurable interest in the damaged property.

§ ~~11.3.2~~ 11.7.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ ~~11.4~~ 11.8 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

~~§11.5~~ § 11.9 Adjustment and Settlement of Insured Loss

§ ~~11.5.1~~ 11.9.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ ~~11.5.2~~ 11.9.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution ~~of~~ or any dispute, the Owner may issue a ~~Construction~~ Contraction Change Directive for the reconstruction of the damaged or destroyed Work.

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ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

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ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the ~~place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.~~State of Louisiana.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

~~§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's Owner's rights and obligations under the Contract Documents.~~ Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.3.3 The Thirty-Second Judicial Court in and for the Parish of Terrebonne, State of Louisiana shall have sole jurisdiction in any action brought under this contract.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. ~~Unless otherwise provided, the~~ The Contractor shall make arrangements for such tests, inspections, and approvals with ~~an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and~~ the testing laboratory provided by the Owner and the Owner shall bear all related costs of tests, inspections, and ~~approvals. The Contractor shall give the Architect timely notice~~ approvals, unless noted otherwise in the Contract Documents. The Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. ~~The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.~~Such costs., except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary

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by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.6 EQUAL OPPORTUNITY

13.6.1 The Contractor shall maintain policies of employment as follows:

.1 The Contractor and the Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, or age. The Contractor shall take affirmative action to insurance that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, national origin, or age. Such action shall include, but not be limited to the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination, rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of nondiscrimination..

.2 The Contractor and the Contractor's Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin or age.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

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§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

.5 failure to complete the punch list within the lien period as provided in 9.8.3.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 ~~Accept assignment of subcontracts pursuant to Section 5.4; and~~

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.2.5 If an agreed sum of liquidated damages has been established, termination by the Owner under this Article will not relieve the Contractor and/or surety of his obligations under the liquidated damages provisions and the Contractor and/or surety shall be liable to the Owner for per diem liquidated damages.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

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§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

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§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation ~~and binding dispute resolution~~ or litigation without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding

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on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue ~~binding dispute resolution~~ litigation proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3

~~**§ 15.3 Mediation**~~

~~**§ 15.3.1** Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.~~

~~**§ 15.3.2** The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.~~

~~**§ 15.3.3** Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.~~

~~**§ 15.3.4** The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.~~

Omitted

§ 15.4 Omitted

~~15.4 Arbitration~~

~~**§ 15.4.1** If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.~~

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§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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PAGES 1

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885 Westside Blvd
Houma, LA 70360

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(Name, legal status and address)

-
Hospital Service District No. 1 – Terrebonne Parish
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Houma, Louisiana 70360

THE ARCHITECT:
(Name, legal status and address)

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PAGES 10-48

See attached AIA Document A201-2017

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I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 10:18:14 ET on 03/29/2022 under Order No. 7651373486 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ - 2017, General Conditions of the Contract for Construction, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

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AIA® Document A310™ – 2010

Bid Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:
(Name, legal status and address)
Hospital Service District No. 1 - Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70361

BOND AMOUNT: $

PROJECT:
(Name, location or address, and Project number, if any)
TGHS Health and Wellness Center
8166 Main Street
Houma, Louisiana 70360

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

DRAFT

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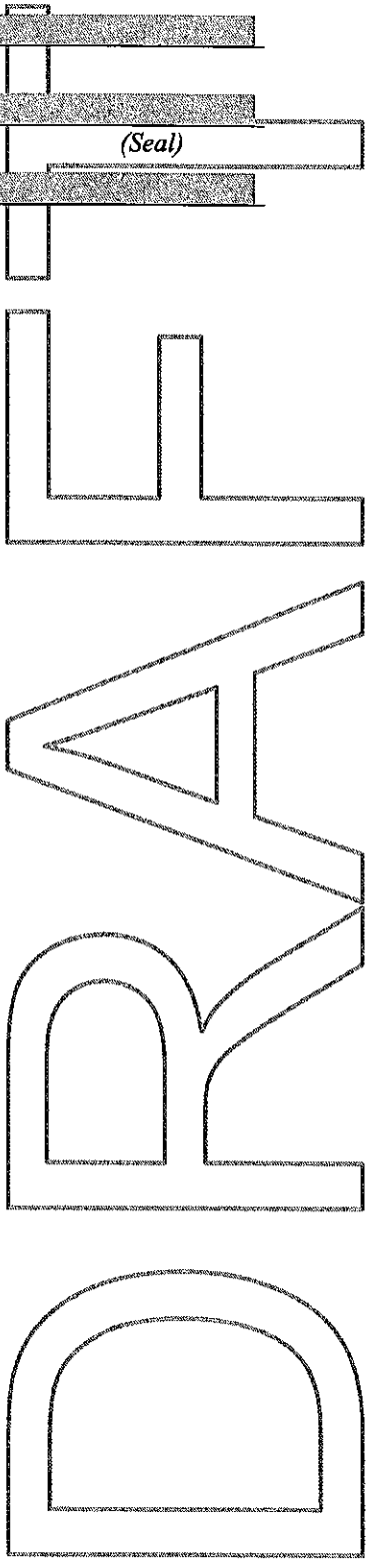
furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

Signed and sealed this [ ] day of [ ],

	(Contractor as Principal) *(Seal)*
(Witness)	*(Title)*
	(Surety) *(Seal)*
(Witness)	*(Title)*



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PAGE 1

OWNER:
(Name, legal status and address)
Hospital Service District No. 1 of the Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

BOND AMOUNT: $

PROJECT:
(Name, location or address, and Project number, if any)
TGHS Health and Wellness Center
885 Westside Blvd.
Houma, Louisiana 70360

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_____

(Signed)

_____

(Title)

_____

(Dated)

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AIA® Document A312® – 2010

Performance Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:
(Name, legal status and address)
Hospital Service District No. 1 - Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

CONSTRUCTION CONTRACT
Date:
Amount: $ ___
Description:
(Name and location)
TGHS Health and Wellness Center
885 Westside Blvd.
Houma, Louisiana 70360

BOND
Date:
(Not earlier than Construction Contract Date)

Amount: $
Modifications to this Bond: None See Section 18

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:		Name and Title:	

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or **BROKER:**

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)
AQ Studios Architecture
1100 Poydras Street, Suite 3550
New Orleans, Louisiana 70163

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

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§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

.2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and

.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

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(1917085560)

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

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Page 1

OWNER:
(Name, legal status and address)
Hospital Service District No. 1 – Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

CONSTRUCTION CONTRACT
Date:
Amount: $ ___
Description:
(Name and location)
TGHS Health and Wellness Center
885 Westside Blvd.
Houma, Louisiana 70360

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(Signed)

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(Title)

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(Dated)

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AIA® Document A312® – 2010

Payment Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:
(Name, legal status and address)
Hospital Service District No. 1 – Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

CONSTRUCTION CONTRACT
Date:
Amount: $ ___
Description:
(Name and location)
TGHS Health and Wellness Center
885 Westside Blvd.
Houma, Louisiana 70360

BOND
Date:
(Not earlier than Construction Contract Date)

Amount: $
Modifications to this Bond: None See Section 18

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:		Name and Title:	

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or **BROKER:**

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)
AQ Studios Architecture
1100 Poydras Street, Suite 3550
New Orleans, Louisiana 70163

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Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

.2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

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§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

- .1 the name of the Claimant;
- .2 the name of the person for whom the labor was done, or materials or equipment furnished;
- .3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
- .4 a brief description of the labor, materials or equipment furnished;
- .5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
- .6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
- .7 the total amount of previous payments received by the Claimant; and
- .8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

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§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

DRAFT

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Additions and Deletions Report for
AIA® Document A312™ – 2010

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

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PAGE 1

OWNER:
(Name, legal status and address)
Hospital Service District No. 1 – Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

CONSTRUCTION CONTRACT
Date:
Amount: $ ___
Description:
(Name and location)
TGHS Health and Wellness Center Surcharge Package
885 Westside Blvd.
Houma, Louisiana 70360

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Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 13:30:01 ET on 12/06/2019 under Order No. 1683616528 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A312™ – 2010, Payment Bond , as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

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CONTRACTOR'S AFFIDAVIT ATTESTING TO NON-SOLICITOUS ACTIVITY

STATE OF LOUISIANA
PARISH OF TERREBONNE

BEFORE ME, the undersigned authority, on this day personally came and appeared:

1) That he is _____ , a duly authorized representative of _____ , whose address is _____ .
2) That on _____ , the said firm did enter into a public contract with Hospital Service District No. 1 of the Parish of Terrebonne, for the construction of the **TGHS Health and Wellness Center Surchage Package, Terrebonne Health System**
3) That the firm has not employed any person, corporation, firm, association, or other organization, either directly or indirectly, to secure the public contract under which he has or will receive payment, other than persons regularly employed by the firm and whose services in connection with the construction of said project or in securing the said public contract were in regular course of their duties for the firm.
4) That no part of the contract price received by affiant was paid nor will be paid to any person, corporation, firm, association, or other organization for soliciting the contract other than the payment of their normal compensation to persons regularly employed by the firm and whose services in connection with the construction of the public project were in regular course of their duties of the firm, so help him God.

_____
CONTRACTOR

SWORN TO AND SUBSCRIBED BEFORE ME,

THIS_____ DAY OF_____20___.

_____
(Notary Public)

END OF SECTION 00 45 60

AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

Hospital Service District No. 1 - ' Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

and the Contractor:
(Name, legal status, address and other information)

-

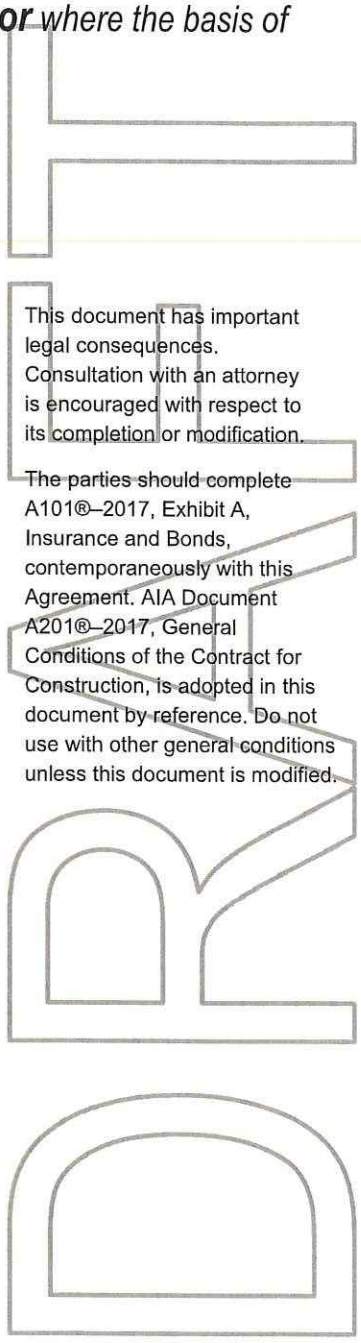
for the following Project:
(Name, location and detailed description)

TGHS Health and Wellness Center
885 Westside Blvd
Houma, Louisiana 70360

The Architect:
(Name, legal status, address and other information)

AQ Studios Architecture
1100 Poydras Street, Suite 3550
New Orleans, Louisiana 70163

The Owner and Contractor agree as follows.



This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[X] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

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[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
N/A	

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be ~~($), ()~~, subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
N/A	

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance
N/A		

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price
N/A	

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)
N/A		

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

The parties agree that time is of the essence in the completion of this Contract. In the event the contractor fails to achieve Substantial Completion within the time stipulated in Section 3.3, then Liquidated Damages are herby stipulated, and shall be assessed against the Contractor, in the amount of One Thousand Dollars. ($1,000.00) per calendar day after the agreed upon Substantial Completion date that the Work is not fully certified by the Architect as being Substantially Complete and, in such event" (a) the Owner shall be authorized and empowered to recover such Liquidated Damages without placing Contractor in default, the Contractor hereby specifically waiving the necessity of being placed in default as required by Louisiana Covil Code Article 2010: and (b) the Owner shall be authorized and empowered to recover such Liquidated Damages by deducting and withholding such sum(s.) from payments of the Contract Sum to which Contractor would otherwise be entitles hereunder, without further legal process.

~~§ 4.6 Other:~~

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§ 4.6 Other:

~~*(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)*~~

(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

N/A

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

N/A

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the Thirtieth day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the Thirtieth day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than Thirty (30) days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

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§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

5% (Five percent)

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

N/A

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

N/A

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

N/A

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect. Contractor shall be required to provide 45 day lien clear certificate from the Reorder of Mortgages for the Parish of Terrebonne and Conscent of Surety agreeing to the release of retainage as part of the final payment on project.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

% N/A

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ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[X] Litigation in ~~a court of competent jurisdiction~~the 32nd JDC, Terrebonne Parish

[ ] Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

N/A

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

Phyllis Peoples
President
Hospital Service District No. 1 - Terrebonne Parish
8166 Main Street
Houma, Louisiana 70361

§ 8.3 The Contractor's representative:

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(Name, address, email address, and other information)

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

N/A

§ 8.7 Other provisions:

8.7.1 No Escrow for Retainage

Owner and Contractor agree that the provisions of Louisiana Revised Statute 9:4857 are not applicable to this contract. In the alternative, Owner and Contractor waive the requirements of Louisiana Revised Statute 9:4857, including but not limited to waiver of those provisions requiring placement of retainage into an escrow account, the use of an escrow agent, and the timing process for retainage payments.

8.7.2 Statutory Employer. In all cases where Contractor's employee (meaning Contractor's direct, borrowed, special or statutory employees) are covered by the Louisiana Worker's Compensation Act, La. R.S. 23:1021 et seq. Owner and Contractor agree that Owner shall be and hereby is designated as the statutory employer of Contractor's direct, borrowed , special and statutory employees, pursuant to la. R.S. 23:1061 (A) (3). Owner and Contractor further agree that the Work is an integral part of and essential to Owner's ability to generate its goods, products and services. This provision is included for the sole purpose of establishing a statutory employer relationship to gain the benefits expressed in la.R.S.23:1061, and is not intended to create an employer/employee relationship for any other purpose. In the event that Owneris required to pay worker's compensation benefits to Contractor's direct, borrowed, special or statutory employees, whether as a statutory employer pursuant to La. R.S. 23:1061 or as a special employer pursuant to La. R.S. 23:1031 (C), Owner shall be entitled to indemnity from Contractor for any such benefit payments. Neither Contractor nor its underwriters shall be entitled to seek contribution from Owner for any worker's compensation benefits payments made on behalf of any Contractor's direct, borrowed, special or statutory employees for purposes of La. R.S. 23:1031 (C). #. It is the intention of the parties that all other terms of the Agreement and/or other Contract Documents not specifically affected by this Amendment will remain unchanged and in full force and effect.

8.7.3 Attorney's Fees.

If as a result of any action or lawsuit filed by the Contractor it is necessary for the Owner to retain an attorney, the Contractor shall pay all legal fees and costs incurred by the Owner, if the Owner is the prevailing party for all or a portion of any claim, in proportion and to the extent the Owner is the prevailing party.

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

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User Notes: (3B9ADA35)

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
.3 AIA Document A201™–2017, General Conditions of the Contract for Construction
~~.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:~~

~~*(Insert the date of the E203-2013 incorporated into this Agreement.)*~~

.5 Drawings

Number	Title	Date	Pages
Exhibit 1 (Attached)	List of Drawings		

~~Number~~	~~Title~~	~~Date~~
-		

.6 Specifications

Section	Title	Date	Pages
Exhibit 2 (Attached)	Table of Contents		

~~Section~~	~~Title~~	~~Date~~	~~Pages~~
-			

.7 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

[ ] The Sustainability Plan:

Title	Date	Pages
N/A	N/A	N/A

[X] Supplementary and other Conditions of the Contract:

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User Notes:
(3B9ADA35)

Document	Title	Date	Pages
Refer to AIA Document A201-2017 as amended	General Conditions of the Contract for Construction	7/23/2021	50

.9 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

N/A

This Agreement entered into as of the day and year first written ~~above.~~above and is executed in at least five (5) original copies of which one (1) is to be delivered to the Contractor, one (1) to the Architect for use in the administration of the Contract, two (2) to the Owner and one (1) for recordation with the Recorder of Mortgages, Parish of Terrebonne.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
Phyllis Peoples, President *(Printed name and title)*	, *(Printed name and title)*

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Additions and Deletions Report for
AIA® Document A101® – 2017

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 10:41:41 ET on 03/29/2022.

PAGE 1

BETWEEN the Owner:
(Name, legal status, address and other information)

Hospital Service District No. 1 of the Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

and the Contractor:
(Name, legal status, address and other information)

-

for the following Project:
(Name, location and detailed description)

TGHS Health and Wellness Center Surcharge Package
885 Westside Blvd
Houma, Louisiana 70360

The Architect:
(Name, legal status, address and other information)

AQ Studios Architecture
1100 Poydras Street, Suite 3550
New Orleans, Louisiana 70163

PAGE 2

[X] A date set forth in a notice to proceed issued by the Owner.

PAGE 3

[X] Not later than Ninety (90) calendar days from the date of commencement of the Work.

...

N/A

...

N/A

...

N/A

...

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N/A

...

N/A

PAGE 4

The parties agree that time is of the essence in the completion of this Contract. In the event the contractor fails to ac hieve Substantial Completion within the time stipulated in Section 3.3, then Liquidated Damages are herby stipulate d, and shall be assessed against the Contractor, in the amount of One Thousand Dollars. ($1,000.00) per calendar da y after the agreed upon Substantial Completion date that the Work is not fully certified by the Architect as being Sub stantially Complete and, in such event" (a) the Owner shall be authorized and empowered to recover such Liquidate d Damages without placing Contractor in default, the Contractor hereby specifically waiving the necessity of being p laced in default as required by Louisiana Covil Code Article 2010: and (b) the Owner shall be authorized and empo wered to recover such Liquidated Damages by deducting and withholding such sum(s.) from payments of the Contra ct Sum to which Contractor would otherwise be entitles hereunder, without further legal process.

...

~~**§ 4.6** Other:~~

...

§ 4.6 Other:

...

~~*(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)*~~

...

(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

...

N/A

...

N/A

...

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the thirtieth day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the Thirteeth day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than Thirty (30) days after the Architect receives the Application for Payment.

PAGE 5

5% (Five percent)

...

N/A

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...

N/A

...

N/A

...

.2 a final Certificate for Payment has been issued by the Architect. Contractor shall be required to provide 45 day lien clear certificate from the Reorder of Mortgages for the Parish of Terrebonne and Conscent of Surety agreeing to the release of retainage as part of the final payment on project.

PAGE 6

% N/A

...

[X] Litigation in a court of competent jurisdiction

...

N/A

PAGE 7

Phyllis Peoples
President
Hospital Service District No. 1 of the Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

...

N/A

...

8.7.1 Statutory Employer. In all cases where Contractor's employee (meaning Contractor's direct, borrowed, special or statutory employees) are covered by the Louisiana Worker's Compensation Act, La. R.S. 23:1021 et seq. Owner and Contractor agree that Owner shall be and hereby is designated as the statutory employer of Contractor's direct, borrowed , special and statutory employees, pursuant to la. R.S. 23:1061 (A) (3). Owner and Contractor further agree that the Work is an integral part of and essential to Owner's ability to generate its goods, products and services. This provision is included for the sole purpose of establishing a statutory employer relationship to gain the benefits expressed in la.R.S.23:1061, and is not intended to create an employer/employee relationship for any other purpose. In the event that Owneris required to pay worker's compensation benefits to Contractor's direct, borrowed, special or statutory employees, whether as a statutory employer pursuant to La. R.S. 23:1061 or as a special employer pursuant to La. R.S. 23:1031 (C), Owner shall be entitled to indemnity from Contractor for any such benefit payments.
Neither Contractor nor its underwriters shall be entitled to seek contribution from Owner for any worker's compensation benefits payments made on behalf of any Contractor's direct, borrowed, special or statutory employees for purposes of La. R.S. 23:1031 (C). #. It is the intention of the parties that all other terms of the Agreement and/or other Contract Documents not specifically affected by thisAmendment will remain unchanged and in full force and effect.

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PAGE 8

~~.4 AIA Document E203™ 2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:~~

...

~~*(Insert the date of the E203-2013 incorporated into this Agreement.)*~~

...

Number	Title	Date
Exhibit 1 (Attached)	List of Drawings	
~~Number~~	~~Title~~	~~Date~~

...

Section	Title	Date	Pages
Exhibit 2 (Attached)	Table of Contents		
~~Section~~	~~Title~~	~~Date~~	~~Pages~~

...

N/A	N/A	N/A

...

[X] Supplementary and other Conditions of the Contract:

...

Refer to AIA Document A201-2017	General Conditions of the Contract for Construction	7/23/2021	50

PAGE 9

N/A

...

This Agreement entered into as of the day and year first written ~~above.~~above and is executed in at least five (5) original copies of which one (1) is to be delivered to the Contractor, one (1) to the Architect for use in the administration of the Contract, two (2) to the Owner and one (1) for recordation with the Recorder of Mortgages, Parish of Terrebonne.

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...

Phyllis Peoples, President

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Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 10:41:41 ET on 03/29/2022 under Order No. 7651373486 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A101™ - 2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

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DRAFT AIA® Document G701® – 2017

Change Order

PROJECT: *(Name and address)*
TGHS Health and Wellness Center
885 Westside Blvd.
Houma, Louisiana 70360

CONTRACT INFORMATION:
Contract For: General Construction

Date:

CHANGE ORDER INFORMATION:
Change Order Number: 001

Date:

OWNER: *(Name and address)*
Hospital Service District No. 1
Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

ARCHITECT: *(Name and address)*
AQ Studios Architecture
1100 Poydras Street, Suite 3550
New Orleans, Louisiana 70163

CONTRACTOR: *(Name and address)*

THE CONTRACT IS CHANGED AS FOLLOWS:
(Insert a detailed description of the change and, if applicable, attach or reference specific exhibits. Also include agreed upon adjustments attributable to executed Construction Change Directives.)

The original Contract Sum was	$ 0.00
The net change by previously authorized Change Orders	$ 0.00
The Contract Sum prior to this Change Order was	$ 0.00
The Contract Sum will be increased by this Change Order in the amount of	$ 0.00
The new Contract Sum including this Change Order will be	$ 0.00

The Contract Time will be increased by Zero (0) days.
The new date of Substantial Completion will be

NOTE: This Change Order does not include adjustments to the Contract Sum or Guaranteed Maximum Price, or the Contract Time, that have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.

NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONTRACTOR AND OWNER.

ARCHITECT *(Firm name)*	CONTRACTOR *(Firm name)*	OWNER *(Firm name)*
AQ Studios Architecture		Hospital Service District No. 1 Parish of Terrebonne
SIGNATURE	SIGNATURE	SIGNATURE
PRINTED NAME AND TITLE	PRINTED NAME AND TITLE	Phyllis Peoples, President PRINTED NAME AND TITLE
DATE	DATE	DATE

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User Notes:
(3B9ADA47)

DRAFT AIA® Document G702® – 1992

Application and Certificate for Payment

TO OWNER:	Hospital Service District No. 1 - Parish of Terrebonne 8166 Main Street Houma, Louisiana 70360	**PROJECT:**	TGHS Health and Wellness Center 855 Westside Blvd. Houma, Louisiana 70360	**APPLICATION NO:** 001 **PERIOD TO:**	**Distribution to:** OWNER: ☒ ARCHITECT: ☒ CONTRACTOR: ☒ FIELD: ☐ OTHER: ☐
FROM CONTRACTOR:		**VIA ARCHITECT:**	AQ Studios Architecture 1100 Poydras Street, Suite 3550 New Orleans, Louisiana 70163	**CONTRACT FOR:** General Construction **CONTRACT DATE:** **PROJECT NOS:** / /	

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
AIA Document G703®, Continuation Sheet, is attached.

1. ORIGINAL CONTRACT SUM		$0.00
2. NET CHANGE BY CHANGE ORDERS		$0.00
3. CONTRACT SUM TO DATE (Line 1 ± 2)		$0.00
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703)		$0.00
5. RETAINAGE:		
a. 0 % of Completed Work (Column D + E on G703)	$0.00	
b. 0 % of Stored Material (Column F on G703)	$0.00	
Total Retainage (Lines 5a + 5b or Total in Column I of G703)		$0.00
6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total)		$0.00
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate)		$0.00
8. CURRENT PAYMENT DUE		$0.00
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6)	$0.00	

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$0.00	$0.00
Total approved this Month	$0.00	$0.00
TOTALS	$0.00	$0.00
NET CHANGES by Change Order		$0.00

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED $0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

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User Notes:

DRAFT AIA® Document G703® – 1992

Continuation Sheet

AIA Document G702®, Application and Certification for Payment, or G732™, Application and Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: 001
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D + E + F)	% (G÷C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**0.00%**	**$0.00**	**$0.00**

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User Notes:

DRAFT AIA® Document G706® – 1994

Contractor's Affidavit of Payment of Debts and Claims

PROJECT: *(Name and address)*
TGHS Health and Wellness Center
885 Westside Blvd
Houma, Louisiana 70360

ARCHITECT'S PROJECT NUMBER:
#21001

CONTRACT FOR: General Construction

CONTRACT DATED:

OWNER: ☐
ARCHITECT: ☐
CONTRACTOR: ☐
SURETY: ☐
OTHER: ☐

TO OWNER: *(Name and address)*
Hospital Service District No. 1 -
Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

STATE OF:
COUNTY OF:

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose

Indicate Attachment ☐ Yes ☒ No

The following supporting documents should be attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: *(Name and address)*

BY:

(Signature of authorized representative)

(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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AIA® Document G706A™ – 1994

Contractor's Affidavit of Release of Liens

PROJECT: *(Name and address)*
TGHS Health and Wellness Center
885 Westside Blvd
Houma, Louisiana 70360

TO OWNER: *(Name and address)*
Hospital Service District No. 1 -
Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

ARCHITECT'S PROJECT NUMBER:

CONTRACT FOR:

CONTRACT DATED:

OWNER: ☐
ARCHITECT: ☐
CONTRACTOR: ☐
SURETY: ☐
OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

CONTRACTOR: *(Name and address)*

BY: _____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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DRAFT AIA® Document G704® – 2017

Certificate of Substantial Completion

PROJECT: *(name and address)*	**CONTRACT INFORMATION:**	**CERTIFICATE INFORMATION:**
TGHS Health and Wellness Center 885 Westside Blvd Houma, Louisiana 70360	Contract For: General Construction Date:	Certificate Number: 001 Date:
OWNER: *(name and address)* Hospital Service District No. 1 Parish of Terrebonne 8166 Main Street Houma, Louisiana 70360	**ARCHITECT:** *(name and address)* AQ Studio 1100 Poydras Street, Suite 3550 New Orlean, LA 70163	**CONTRACTOR:** *(name and address)*

The Work identified below has been reviewed and found, to the Architect's best knowledge, information, and belief, to be substantially complete. Substantial Completion is the stage in the progress of the Work when the Work or designated portion is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The date of Substantial Completion of the Project or portion designated below is the date established by this Certificate.
(Identify the Work, or portion thereof, that is substantially complete.)

ARCHITECT *(Firm Name)*	**SIGNATURE**	**PRINTED NAME AND TITLE**	**DATE OF SUBSTANTIAL COMPLETION**

WARRANTIES
The date of Substantial Completion of the Project or portion designated above is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below:
(Identify warranties that do not commence on the date of Substantial Completion, if any, and indicate their date of commencement.)

WORK TO BE COMPLETED OR CORRECTED
A list of items to be completed or corrected is attached hereto, or transmitted as agreed upon by the parties, and identified as follows:
(Identify the list of Work to be completed or corrected.)

The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Unless otherwise agreed to in writing, the date of commencement of warranties for items on the attached list will be the date of issuance of the final Certificate of Payment or the date of final payment, whichever occurs first.
The Contractor will complete or correct the Work on the list of items attached hereto within ( ) days from the above date of Substantial Completion.

Cost estimate of Work to be completed or corrected: $

The responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work, insurance, and other items identified below shall be as follows:
(Note: Owner's and Contractor's legal and insurance counsel should review insurance requirements and coverage.)

The Owner and Contractor hereby accept the responsibilities assigned to them in this Certificate of Substantial Completion:

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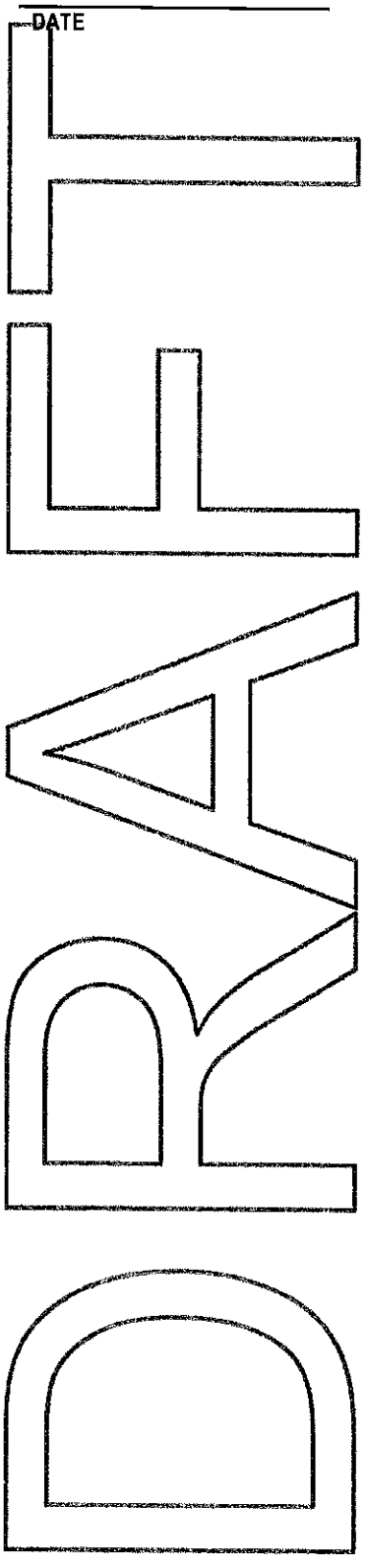
(3B9ADA4B)

CONTRACTOR *(Firm Name)*	SIGNATURE	PRINTED NAME AND TITLE	DATE
Hospital Service District No. 1 - Terrebonne Parish		Phyllis Peoples ,President	
OWNER *(Firm Name)*	**SIGNATURE**	**PRINTED NAME AND TITLE**	**DATE**



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Consent Of Surety to Final Payment

PROJECT: *(Name and address)*

TGHS Health and Wellness Center
885 Westside Blvd
Houma, Louisiana 70360

ARCHITECT'S PROJECT NUMBER:

#21001

CONTRACT FOR: General Construction

CONTRACT DATED:

OWNER: ☐
ARCHITECT: ☐
CONTRACTOR: ☐
SURETY: ☐
OTHER: ☐

TO OWNER: *(Name and address)*
Hospital Service District No. 1
Parish of Terrebonne
8166 Main Street
Houma, Louisiana 70360

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the
(Insert name and address of Surety)

, SURETY,

on bond of
(Insert name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to
(Insert name and address of Owner)

, OWNER,

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date:
(Insert in writing the month followed by the numeric date and year.)

(Surety)

(Signature of authorized representative)

Attest:
(Seal):

(Printed name and title)

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TGMC	*Terrebonne General Medical Center* *Policy and Procedure*		
Title: Infection Control During Construction		**Control No.: 8345-IC**	**Version: 9**
Replaces: v.8 Infection Control During Construction			
Policy Owner: Charlotte Boudreaux (Infection Control Manager)			
Reviewers: Charles Schefferstein (Manager)			
Approved By: Infection Control Committee (Chairman), Teresita McNabb (VP of Nursing)		**Approved Date: 05/28/2018**	**Date Last Reviewed Date: 05/31/2019**

Purpose:

The purpose of this policy is to provide a process to identify and minimize the varying degrees of risk to patients, staff, and visitors during construction and renovation activities undertaken at TGMC.

Policy:

It is the policy of TGMC to maintain the highest level of infection control during any construction or renovation project to eliminate, to the extent possible, airborne contaminants, vibration and noise generating activities from construction and maintenance projects in areas, in which they may have an adverse impact on patient care.

Definitions:

Supportive Data:

Background Information: The Joint Commission on Accreditation for Health Care Organizations has established Environment of Care (EC) standards for evaluation the quality of the patient care environment. Construction projects can create a large amount of air borne contaminations, vibration, and noise generating activities during the demolition, and reconstruction phases of the project. These air borne contaminations can include fungi, dust, vapors and odors, which maybe be detrimental to patients and other persons in the hospital. This policy will also provide methods to include infection control prevention/design containment strategies in the design process. These strategies include:

- Evaluating the project effect on patient care services including the identification of possible disruptions to core services and alternative plans to maintain them.
- Reviewing planned projects and their potential effect on patient population.
- Identifying and implementing appropriate levels of precaution and containment to minimize the risk of nosocomial infections.
- Reviewing planned project drawings and specifications to assure that safety and Infection control methods have been incorporated.
- Identify methods to minimize the effects of other hazards such as noise, vibration, etc.

Equipment:

References:

The Joint Commission Standard, Guidelines for Design and Construction of Health Care Facilities, 2010 edition

Procedure:

A. The Infection Control Department will be involved in the planning and design of all new construction and renovation projects. The design will support current infection control practices.
B. Before initiating any new construction or renovation project, the Facility Management Department will evaluate the project using the Infection Control During Construction - Risk Assessment - Form
    1. Projects shall be classified into four levels of infection control precautions by class. The level of precaution is determined by completing the 14 step risk assessment form.
    2. For all projects, Infection Control precautions are necessary during and upon completion of the project as outlined in Infection Control Risk Assessment Form
C. Based on this assessment an individualized Infection Control Permit is completed as outlined in the Infection Control Risk Assessment Form
        1.Class I and II projects do not require an Infection Control Permit – Facilities Management Department will meet with contractor to discuss needed infection control precautions. A contract will be signed by both parties acknowledging needed precautions.
        2.Class III and IV projects require an Infection Control Permit. Facility Management Department, Contractor, and Infection Control will meet to discuss needed infection control precautions prior to bidding stage. Once a bid is accepted a contract will then be signed by all parties outlining the previously stated infection control precautions necessary during the construction phase and an Infection Control Permit will be initiated.
D. The Facilities Management Department will inspect all job sites daily for compliance to infection control guidelines.
E. At any time Facilities Management or Infection Control may ask to review this permit. Should probable cause exist, these individuals can immediately stop all work on the project until either a valid permit has been issued or any compliance issues resolved.
F. A complete list of open Infection Control Permits will be maintained in the Facilities Management Department until completion of the job.
G. It is the responsibility of the Facilities Management Department to close all permits upon completion of the project.

Terrebonne General Medical Center Policy and Procedure

Title: Interim Life Safety Measures	**Control No.:8370H018**	**Version: 3**
Replaces: Interim Life Safety Measures		
Policy Owner: Charles Schefferstein (Facility Manager) Facilities Management		
Reviewers: Percy Mosely Security		
Approvers: Troy Ledet (Director) Facilities Management	**Date Approved:10/29/14**	**Date last approved: 1/9/20**

Policy:
There will be a program in place which ensures that proper actions are initiated, instituted and documented to temporarily compensate for hazards posed by Life Safety Code deficiencies and construction activities.
This program will be called Interim Life Safety Measures (ILSM) it will be used to temporarily compensate for hazards posed by existing NFPA 101 Life Safety Code deficiencies or construction activities.

Purpose:
To ensure that the safety of the building occupants is not jeopardized during construction, renovations and related activities.

- The Interim Life Safety Measures policy and procedure is reviewed and approved by the Environment of Care Committee.
- The implementation of Interim Life Safety Measures shall be initiated by Facility Management, the Chairman of the Environment of Care Committee or the Safety Officer.
- Monitoring to determine the need for an ILSM shall include:
    - Staff reports
    - Fire alarm and suppression failures
    - Reviewing the hospital's Electronic Statement of Condition (e-SOC)
    - Routine environmental tours
    - Continuously assessing constructions and renovation plans as applicable
- Interim Life Safety Measures must be followed by all staff, patients, visitors, vendors and construction workers.
- The Facility Manager, Safety Officer, and the Environment of Care Committee, shall implement the Interim Life Safety Measures

Actions used to compensate for Life Safety impairments
Interim life safety measures are a series of administrative actions which may be required to provide temporary compensation for hazards posed by construction related activities. These measures include, but are not limited to:

1. The hospital notifies the fire department (or other emergency response group) and initiates a fire watch when a fire alarm or sprinkler system is out of service more than 4

hours in a 24-hour period in an occupied building. Notification and fire watch times are documented.

2. The hospital posts signage identifying the location of alternate exits to everyone affected
3. The hospital has a written Interim Life Safety Measure (ILSM) policy that covers situations when Life Safety Code deficiencies cannot be immediately corrected or during periods of construction. The policy includes criteria for evaluating when and to what extent the hospital follows special measures to compensate for increased life safety risk.
4. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Inspects exits in affected areas on a daily basis. The need for these inspections is based upon criteria in the hospital's Interim Life Safety Measure (ILSM) policy.
5. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Provides temporary but equivalent fire alarm and detection systems for use when a fire system is impaired. The need for equivalent systems is evaluated by Facility Manager or his designee in association with the Construction Manager.
6. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Provides additional fire-fighting equipment. The need for this equipment is evaluated by Facility Manager or his designee in association with the Construction Manager.
7. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Uses temporary construction partitions that are smoke-tight, or made of noncombustible material, or made of limited combustible material that will not contribute to the development or spread of fire. The need for these partitions is evaluated by Facility Manager or his designee in association with the Construction Manager.
8. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Increases surveillance of buildings, grounds, and equipment, giving special attention to construction areas and storage, excavation, and field offices. The need for increased surveillance is evaluated by Facility Manager or his designee in association with the Construction Manager.
9. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Enforces storage, housekeeping, and debris removal practices that reduce the building’s flammable and combustible fire load to the lowest feasible level. The need for these practices is evaluated by Facility Manager or his designee in association with the Construction Manager.
10. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Provides additional training to those who work in the hospital on the use of fire-fighting equipment. The need for additional training is evaluated by Facility Manager or his designee in association with the Construction Manager.
11. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Conducts one additional fire drill per shift per quarter. The need for additional drills is evaluated by Facility Manager or his designee in association with the Construction Manager.
12. When the hospital identifies Life Safety Code (LSC) deficiencies that cannot be immediately corrected or during periods of construction, the hospital does the following: Inspects and tests temporary systems monthly. The completion date of the tests is documented. The need for these inspections and tests is evaluated by Facility Manager or his designee in association with the Construction Manager.

13. The hospital conducts education to promote awareness of building deficiencies, construction hazards, and temporary measures implemented to maintain fire safety. The need for education is evaluated by Facility Manager or his designee in association with the Construction Manager.
14. The hospital trains those who work in the hospital to compensate for impaired structural or compartmental fire safety features. The need for training is evaluated by Facility Manager or his designee in association with the Construction Manager. (See also LS.01.01.01 EP 3)Note: Compartmentalization is the concept of using various building components (fire rated walls and doors, smoke barriers, fire rated floor slabs, and so forth) to prevent the spread of fire and the products of combustion such as to provide a safe means of egress to an approved exit.

Procedure:

- Facility Manager:
    - Shall be notified before the start of any construction
    - Shall attend design/construction meetings to determine if interim life safety measures shall be implemented
    - He/she shall prepare an ILSM assessment of the project
    - He/she shall meet with contractors before the beginning of construction to brief them on hospital policy.
    - He/she shall perform daily on site inspections:
        - Any deficiencies shall be reported to the Construction Project Manager for correction as soon as possible.
        - Any deficiencies observed that are an immediate threat to life and health shall be corrected immediately.
        - Weekends and holiday inspections shall be conducted by security
- He/she Is authorized to shut down any projects that are not meeting ILSM
    - If a project must be halted, the Facility Manager shall notify the following individuals:
        - Environment of Care Committee
        - Construction Project Manager
        - Administration
        - Facility Management Director
    - Modifications must be reviewed before construction may resume.
- The contractor is responsible for posting signage addressing warning notifications at all entrances to the work site.
- Additional fire drills and training will be conducted when conditions warrant in the affected areas.
- Proper barricades (interior and exterior) will be used.
- Hot work permits shall be obtains and contractors will implement and fellow all guidelines contained in the permit. A fire watch will be use when cutting and/or brazing torches are being used, or when interruptions are made in the fire warning system
- Flammable liquids will be properly stored in a flammable storage cabinet
- Contractors shall be responsible for training their crew on ILSMs.

Evaluating & Implementation

ILSM assessment

During the planning stage of any construction or renovation project, a meeting will be held between the Facility Manager, the Construction Manager, and as applicable, the Architect, for responsible for completion of the project. They will review the scope of the project and make efforts to determine if the project will impact the life safety features of the hospital.

The project shall be assessed by the Facility Manager. The Interim Life Safety assessment form shall be completed and scored to determine the degree of life safety impairment during the project and at which stage of the project such impairments would exist.

For each question that is answered yes a detailed assessment of applicability of the measures will be undertaken.

1. The individual assigned will develop implementation schedules(s), actions, and if necessary, means of documentation of the activities.
2. Documentation will be filed by project title.
3. The status of ILSM's for each project will be reviewed by the Environment of Care Committee.
4. Using the 14 above points, The Facility Manager shall initiate appropriate ILSM anytime a lapse in LSC compliance is evident. Each LSC lapse shall be evaluating as to what extent the hospital follows special measures to compensate for increased life safety risk

INTERIM LIFE SAFETY & INFECTION CONTROL DAILY INSPECTION CHECKLIST

PROJECT/AREA inspected: _____ Month/Year: _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
- Are exits clear and unobstructed?																															
- Are exit signs lighted? Temporary exit signs installed?																															
- Has staff been trained on alternate egress routes? (Document on reverse side of this form)																															
- Are doors leading into fire exit stairways being kept closed and latched?																															
- Is access to Emergency services, patient services and for emergency agencies free and unobstructed																															
- Have at least 2 ABC-type extinguishers been provided in the construction area																															
- Have fire alarm or sprinkler systems been impaired? If so, have the proper authorities been notifiec																															
- Has Fire Watch been implemented or are fire alarm/fire sprinklers being re-activated at end of shift?																															
- Document monthly testing of temporary systems																															
- Document staff training of fire fighting equipment on reverse side of this form																															
- Are flammable liquids being used? If so, are they being kept to a minimum and stored in a metal cabinet when not in use?																															
- Document 2 fire drills per shift per quarter																															
- Is the area free of trash accumulation and corridors free of construction debris/material?																															
- Is the amount of combustible material in the area being kept to a minimum?																															
- Has a temporary non-combustible partition been constructed where a smoke partition has been breached or compromised?																															
- Is the "no smoking" policy being followed?																															
- Is power equipment running unattended?																															
- Is cutting or welding being performed? If so, has a permit been issued and prominently displayed																															
Initials:																															

comments:

TERREBONNE GENERAL MEDICAL CENTER
INTERIM LIFE SAFETY ASSESSMENT

Project name

		YES	NO
A.	Will any exits become blocked or obstructed and will temporary exit signage identifying alternate exits be necessary? IF YES, DO 1, 2 & 3		
B.	Will access to the ER become blocked or obstructed? IF YES, DO 1, 4 & 11		
C.	Will part of any fire alarm, detection, and/or suppression system be impaired or shut-down more than 4-hrs in a 24-hr period? IF YES, DO 5, 6, 9, 10 &11		
D.	Will temporary, but equivalent fire alarm, detection, or fire-fighting equipment be necessary? IF YES, DO 2, 3, 6, 9 & 10		
E.	Will smoke or fire walls be breached or structural or compartmental fire safety features compromised? IF YES, DO 2 & 10		
F.	Will it be necessary to erect any temporary construction partitions? IF YES, DO 7 & 11		
G.	Will the project result in the accumulation of debris or construction materials? IF YES, DO 2, 8, & 9		
H.	Will construction effect ground's safety (storage, excavations, equipment, etc.)? IF YES, DO 10 &11		
I.	Will construction present other safety hazards? IF YES, DO 10 & 11		

"DO" ACTIONS

1. Post signage and document personnel training for alternative means of egress.
2. Adopt and document daily inspections of construction areas.
3. Conduct and document 2 fire drills per shift per quarter.
4. Meet with ER staff, EMS, Fire Dept. to develop plans; document.
5. Institute Fire Watch and develop alternate systems/policies (i.e. - covering smoke heads during welding operations and uncovering at end of each shift).
6. Test and document temporary systems monthly
7. Document fire resistive rating of partition material/structure.
8. Develop storage, housekeeping and debris removal policies/procedures.
9. Provide fire-fighting equipment and user training; document.
10. Provide training related to other safety hazards.
11. Increase surveillance of buildings, grounds and equipment, especially construction areas.

This is a planning guide only. To DO items may be omitted at the discretion of the Facility Manager. For each item from the "DO" list a separate action plan may need to be developed to assign responsibility and schedule. This hospital is smoke free and policies related to smoking are not required

Evaluated by

Infection Control Risk Assessment
Matrix of Precautions for Construction & Renovation

Step One:
Using the following table, *identify* the Type of Construction Project Activity (Type A-D)

TYPE A	**Inspection and Non-Invasive Activities**. Includes, but is not limited to: ▪ removal of ceiling tiles for visual inspection limited to 1 tile per 50 square feet ▪ painting (but not sanding) ▪ wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	**Small scale, short duration activities which create minimal dust** Includes, but is not limited to: ▪ installation of telephone and computer cabling ▪ access to chase spaces ▪ cutting of walls or ceiling where dust migration can be controlled.
TYPE C	**Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies** Includes, but is not limited to: ▪ sanding of walls for painting or wall covering ▪ removal of floorcoverings, ceiling tiles and casework ▪ new wall construction ▪ minor duct work or electrical work above ceilings ▪ major cabling activities ▪ any activity which cannot be completed within a single workshift.
TYPE D	**Major demolition and construction projects** Includes, but is not limited to: ▪ activities which require consecutive work shifts ▪ requires heavy demolition or removal of a complete cabling system ▪ new construction.

Step 1__ _____

Steps 1-3 Adapted with permission V Kennedy, B Barnard, St Luke Episcopal Hospital, Houston TX; C Fine, CA
Steps 4-14 Adapted with permission Fairview University Medical Center, Minneapolis MN
Forms modified and provided courtesy of J Bartley, ECSI Inc ,Beverly Hills MI 2002

Step Two:

Using the following table, ***identify*** **the Patient Risk Groups** that will be affected.
If more than one risk group will be affected, select the higher risk group:

Low Risk	Medium Risk	High Risk	Highest Risk
▪ Office areas	▪ Cardiology ▪ Echocardiography ▪ Endoscopy ▪ Nuclear Medicine ▪ Physical Therapy ▪ Radiology/MRI ▪ Respiratory Therapy	▪ CCU ▪ Emergency Room ▪ Labor & Delivery ▪ Laboratories (specimen) ▪ Newborn Nursery ▪ Outpatient Surgery ▪ Pediatrics ▪ Pharmacy ▪ Post Anesthesia Care Unit ▪ Surgical Units	▪ Any area caring for immunocompromised patients ▪ Burn Unit ▪ Cardiac Cath Lab ▪ Central Sterile Supply ▪ Intensive Care Units ▪ Medical Unit ▪ Negative pressure isolation rooms ▪ Oncology ▪ Operating rooms including C-section rooms

Step Two_ _____

Step Three: Match the

Patient Risk Group (***Low, Medium, High, Highest***) with the planned **…**
Construction Project Type (***A, B, C, D***) on the following matrix, to find the **…**
Class of Precautions (***I, II, III or IV***) or level of infection control activities required.

Class I-IV or Color-Coded Precautions are delineated on the following page.

IC Matrix - Class of Precautions: Construction Project by Patient Risk

Patient Risk Group	Construction Project Type: TYPE A	TYPE B	TYPE C	TYPE D
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
HIGHEST Risk Group	II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that **Class III** or **Class IV** control procedures are necessary.

Step 3__ _____

Description of Required Infection Control Precautions by Class

During Construction Project **Upon Completion of Project**

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Steps 4-14 Adapted with permission Fairview University Medical Center, Minneapolis MN
Forms modified and provided courtesy of J Bartley, ECSI Inc Beverly Hills MI 2002

CLASS I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection	1. Clean work area upon completion of task.
CLASS II	1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area 6. Remove or isolate HVAC system in areas where work is being performed.	1. Wipe work surfaces with disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Remove isolation of HVAC system in areas where work is being performed.
CLASS III	1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid.	1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department. 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with disinfectant. 5. Remove isolation of HVAC system in areas where work is being performed.
CLASS IV	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures appropriately. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 7. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department.	1. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 2. Contain construction waste before transport in tightly covered containers. 3. Cover transport receptacles or carts. Tape covering unless solid lid 4. Vacuum work area with HEPA filtered vacuums. 5. Wet mop area with disinfectant. 6. Remove isolation of HVAC system in areas where work is being performed.

Step 4. **Identify the areas surrounding the project area, assessing potential impact**

Unit Below	Unit Above	Lateral	Lateral	Behind	Front
Risk Group	Risk Group	Risk Group	Risk Group	Risk Group	Risk Group

Step 5. **Identify specific site of activity eg, patient rooms, medication room, etc.**

__ _____

Step 6. **Identify issues related to: ventilation, plumbing, electrical in terms of the occurrence of probable outages.**

_ _____

Step 7. **Identify containment measures, using prior assessment. What types of barriers? (Eg, solids wall barriers); Will HEPA filtration be required?**

___ _____

(Note: Renovation/construction area shall be isolated from the occupied areas during construction and shall be negative with respect to surrounding areas)

Step 8. **Consider potential risk of water damage. Is there a risk due to compromising structural integrity? (eg, wall, ceiling, roof)**

N/A

Step 9. **Work hours: Can or will the work be done during non-patient care hours?**

N/A

Step 10. **Do plans allow for adequate number of isolation/negative airflow rooms?**

N/A

Step 11. **Do the plans allow for the required number & type of handwashing sinks?**

Yes

Step 12. **Does the infection control staff agree with the minimum number of sinks for this project?**

(Verify against AIA Guidelines for types and area)

Yes

Step 13. **Does the infection control staff agree with the plans relative to clean and soiled utility rooms?**

N/A

Step 14. **Plan to discuss the following containment issues with the project team.**
Eg, traffic flow, housekeeping, debris removal (how and when),

_____

_____

_____

Appendix: Identify and communicate the responsibility for project monitoring that includes infection control concerns and risks. The ICRA may be modified throughout the project. Revisions must be communicated to the Project Manager.

Infection Control Construction Permit

					Permit No:
Location of Construction:				Project Start Date:	
Project Coordinator:				Estimated Duration:	
Contractor Performing Work				Permit Expiration Date:	
Supervisor:				Telephone:	
YES	NO	CONSTRUCTION ACTIVITY	YES	NO	INFECTION CONTROL RISK GROUP
		TYPE A: Inspection, non-invasive activity			GROUP 1: Low Risk
		TYPE B: Small scale, short duration, moderate to high levels			GROUP 2: Medium Risk
		TYPE C: Activity generates moderate to high levels of dust, requires greater 1 work shift for completion			GROUP 3: Medium/High Risk
		TYPE D: Major duration and construction activities Requiring consecutive work shifts			GROUP 4: Highest Risk

CLASS I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace any ceiling tile displaced for visual inspection.	3. Minor Demolition for Remodeling
CLASS II	1. Provides active means to prevent air-borne dust from dispersing into atmosphere 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Wipe surfaces with disinfectant.	6. Contain construction waste before transport in tightly covered containers. 7. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 8. Place dust mat at entrance and exit of work area. 9. Remove or isolate HVAC system in areas where work is being performed.
CLASS III **Date** **Initial**	1. Obtain infection control permit before construction begins. 2. Isolate HVAC system in area where work is being done to prevent contamination of the duct system. 3. Complete all critical barriers or implement control cube method before construction begins. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5. Do not remove barriers from work area until complete project is thoroughly cleaned by Env. Services Dept.	6. Vacuum work with HEPA filtered vacuums. 7. Wet mop with disinfectant 8. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 9. Contain construction waste before transport in tightly covered containers. 10. Cover transport receptacles or carts. Tape covering. 11. Remove or isolate HVAC system in areas where work is being performed/
Class IV **Date** **Initial**	1. Obtain infection control permit before construction begins. 2. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 3. Complete all critical barriers or implement control cube method before construction begins. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5. Seal holes, pipes, conduits, and punctures appropriately. 6. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site.	7. All personnel entering work site are required to wear shoe covers 8. Do not remove barriers from work area until completed project is thoroughly cleaned by the Environmental Service Dept. 9. Vacuum work area with HEPA filtered vacuums. 10. Wet mop with disinfectant. 11. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 12. Contain construction waste before transport in tightly covered containers. 13. Cover transport receptacles or carts. Tape covering. 14. Remove or isolate HVAC system in areas where is being done.

Additional Requirements: **Inspection Daily – Report problems to IC**

_____ Date Initials	_____Exceptions/Additions to this permit Date Initials are noted by attached memoranda
Permit Request By:	Permit Authorized By:
Date:	Date:

PROJECT_____ **MONTH**_____

INFECTION CONTROL DAILY INSPECTION

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NO PROBLEM NOTED																															
COMPLETED BY																															
JOB SITE CLEAN																															
DUST BARRIERS																															
SEWER LINES CAPPED																															
STANDING WATER																															
OPENINGS SEALED																															
DUCTS SEALED																															
TEMPORARY BARRIERS																															
SITE FREE OF DEBRIS																															
NO INSECTS OR PEST																															
NO NOISE																															
NO VIBRATIONS																															
NEGATIVE PRESSURE COFIRMED																															

Check = OK
X = Deficiency

REQUEST FOR INFORMATION

From: _____
_____
_____
_____

Project: _____
_____
_____

Project No. _____

To: Giulia Irwin
AQ Studios Architecture
1100 Poydras St., Suite 3550
New Orleans, LA 70163
T: 504.524.4375
giulia@aqteam.com

RFI No: _____

Attachment: _____Yes _____ No

Attn: _____

Date Response Requested: _____

Reference: Spec Section: _____

Drawings:_____

Question:_____
_____
_____
_____
_____
_____

Proposed
Solution:_____
_____
_____
_____
_____
_____

Signed:_____

Date: _____

P.O.R.
Response:_____
_____
_____
_____
_____
_____

Signed: _____

Date:_____

Cc:

DIVISION

01

GENERAL REQUIREMENTS

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
Project information.
Work covered by Contract Documents.
Purchase contracts.
Access to site.
Coordination with occupants.
Work restrictions.
Specification and drawing conventions.

B. Related Section:
Division 01 Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Terrebonne General Health System, Health & Wellness Center
Project Number: 21001
Project Location: Westside Blvd Extension, Houma, LA 70360

B. Owner: Hospital Service District No. 1 of the Parish of Terrebonne
Owner's Representative: TBD

C. Architect: AQ Studios Architecture , 1100 Poydras St Suite 3550, New Orleans LA 70163

D. Project Web Site: A Project Web site administered by the Contractor will be used for purposes of managing communication and documents during the construction stage.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:

B. Project Description

1. This is a single contract project consisting of a new construction of a medical office and wellness building.

C. Type of Contract

1. Project will be constructed under a single prime contract.

1.5 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.
Installation of FFE items provided by Owner contractor.

1.6 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

1.8 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
Architect will prepare a Certificate of Substantial Completion for the Work to be occupied prior to Owner acceptance of the completed Work.
Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

B. Owner intends to fully occupy the Project upon Substantial Completion.

1.9 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. Coordinate construction work sequence schedule and operations with Owner.

C. Nonsmoking Building: Smoking is not permitted within the building or while on Terrebonne General Health System's site.

D. Controlled Substances: Use of tobacco products and other controlled substances on the Project site is not permitted.

E. Employee Identification: Owner will provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.

1.10 APPROVAL AGENCIES

A. - The Contractor shall apply to the Parish of Terrebonne, for the Building Permit and pay all required fees.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Sections:
1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
2. Divisions 02 through 32 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.4 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use facsimile of form provided in the Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.

f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation. Architect will announce acceptance of proposed substitution.

a. Forms of Acceptance: Addendum
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit request for substitution in accordance with the Instructions for Bidders.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.

f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____ In substitution of _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution. (Pending approval by BASF Wall Systems)

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 012500
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 012500
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections:

1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within 5 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    e. Quotation Form: Use forms acceptable to Architect

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including Supplementary Conditions and other Division 01 Specification Sections apply to this Section.

1.2 SUMMARY:

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment. Coordinate the Schedule of Values and Applications for Payment with the Contractor's Construction Schedule, List of Subcontractors, and Submittal Schedule. The Contractor's Construction Schedule and Submittal Schedule are included in Section 01 33 00: Submittal Procedures.

1.3 SCHEDULE OF VALUES:

A. Format and Content:
   1. Use the Schedule of Values form provided in the Project Manual, Division 00 as a guide to establish the format. Include the following project identification on the Schedule of Values:
      a. Project Name and Location
      b. Name of the Architect
      c. State Project Number
      d. Contractor's Name and Address
      e. Date of Submittal

B. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

C. Schedule of Updating:
   1. Update and resubmit the Schedule of Values when Change Orders or Construction Change directives result in a change in the Contract Sum, by adding each Change Order as a line item.

1.4 1.4 APPLICATION FOR PAYMENT:

A. Each Application for Payment shall be consistent with previous applications and payments as certified and paid for by Owner. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment Application Times:
   1. Each progress payment date is as indicated in the Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Applications Forms:
   1. Use AIA Document G-702 and Continuation Sheets G703 as the form for Application for Payment. Refer to sample in this Specification.

D. Application Preparation:
   1. Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Contractor. Incomplete or incorrect applications will be returned without action. Entries shall match data on the Schedule of Values. Include amounts of Change Orders and construction change directives issued prior to the last day of the construction period covered by the application.

E. Transmittal:
   1. Submit two (2) executed copies of each Application for Payment to the Architect by means ensuring receipt within 24 hours; one copy shall be complete, including waivers of lien and similar attachments, when required. Transmit each copy with a Transmittal Form listing attachments and recording appropriate information related to the application in a manner acceptable to the Architect.

F. Initial Application for Payment:
   1. Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:
      a. List of Subcontractors
      b. List of Principal Suppliers and Fabricators
      c. Schedule of Values
      d. Contractor's Construction Schedule (Preliminary, if not final)

G. Application for Payment at Substantial Completion:
   1. Following issuance of the Certificate of Substantial Completion, submit an Application for Payment.

H. Administrative actions and submittals that shall precede or coincide with this application include:
   1. Warranties (Guarantees) and Maintenance Agreements
   2. Maintenance Instructions
   3. Final Cleaning
   4. Consent of Surety
   5. List of Incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion

I. Final Payment Application:
   1. Administrative actions and submittals, which must precede or coincide with submittal of the Final Payment Application for Payment, include the following:
      a. Lien Free Certificate
      b. Completion of Project Closeout Requirements
      c. Completion of Items Specified for Completion after Substantial Completion
      d. Assurance that unsettled Claims will be settled
      e. Transmittal of required Project Construction Records
      f. Proof that taxes, fees and similar obligations have been paid
      g. Removal of temporary facilities and services
      h. Removal of surplus materials, rubbish and similar elements
      i. Consent of Surety to Final Payment(AIA Form G707)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 29 00

SECTION 01 31 00 – CONSTRUCTION SCHEDULES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work included: To assure adequate planning and execution of the Work so that the Work is completed within the number of calendar days allowed in the Contract, and to assist the Architect in appraising the reasonableness of the proposed schedule and in evaluating progress of the Work, prepare and maintain the schedules and reports described in the Section.

B. Related Work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   2. Requirements for progress schedule: General Conditions.
   3. Construction period: Refer to Instructions to Bidders

C. Definitions:
   1. "Day", as used throughout the Contract unless otherwise stated, means "calendar day."

1.2 QUALITY ASSURANCE

A. Employ a scheduler who is thoroughly trained and experienced in compiling construction schedule data, and in preparing and issuing periodic reports as required below.

B. Perform data preparation, analysis, charting, and updating in accordance with standards approved by the Architect.

C. Reliance upon the approved schedule:
   1. The Construction Schedule as approved by the Architect will be an integral part of the Contract and will establish interim completion dates for the various activities under the Contract.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01 33 00.

B. Preliminary Schedule: Within five (5) calendar days after the Contractor has received the Owner's Notice to Proceed, submit one (1) copy of preliminary construction schedule prepared in accordance with Part 3 of this Section.

C. Construction Schedule: Within 10 calendar days after the Contractor has received the Owner's Notice to Proceed, submit one (1) computer disk copy and four (4) prints of construction schedule prepared in accordance with Part 3 of this Section.

D. Periodic Reports: On the first working day of each month following the submittal described in Paragraph 1.3-C above, submit four (4) prints of construction schedule updated as described in Part 3 of this Section.

PART 2 – PRODUCTS

2.1 CONSTRUCTION SCHEDULE

A. Graphically show by bar-chart the order and interdependence of all activities necessary to complete the Work, and the sequence in which each activity is to be accomplished, as planned by the Contractor and his project field superintendent in coordination with all subcontractors whose work is shown on the diagram.

B. Include, but do not necessarily limit indicated activities to:
   1. Project mobilization;
   2. Submittal and approval of Shop Drawings and Samples;
   3. Procurement of equipment and critical materials;
   4. Fabrication of special material and equipment, and its installation and testing;
   5. Milestone dates based on phasing requirements;
   6. Final cleanup;
   7. Final inspecting and testing, and
   8. All activities by the Architect that effect progress, required dates for completion, or both, for all and each part of the Work.

PART 3 – EXECUTION

3.1 PRELIMINARY SCHEDULE

A. Contents:
   1. Show all activities of the Contractor under this Work for the period between receipt of Notice to Proceed and submittal of construction schedule required under Paragraph 1.3-C above;
   2. Show the Contractor's general approach to reminder of the Work;
   3. Show cost of all activities scheduled for performance before submittal and approval of the Construction Schedule.

B. Submit in accordance with Paragraph 1.3-B above.

3.2 CONSTRUCTION SCHEDULE

A. **WITHIN FIVE (5) DAYS** after receipt of Notice to Proceed, complete the Construction Schedule in preliminary form, meet with the Architect and Owner, review contents of the proposed construction schedule and make all revisions agreed upon.

3.3 PERIODIC REPORTS

A. As required under Paragraph 1.3-D above, update the approved construction schedule.
   1. Indicate "actual" progress in percent completion for each activity;
   2. Provide written narrative summary of revisions causing delay in the program, and an explanation of corrective actions taken or proposed.

END OF SECTION 01 31 00

SECTION 01 31 13 – COORDINATION VIA BIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes special procedures for coordinating and preplanning construction operations on Project including, but not limited to, the following:

1. 3D MEPFP coordination procedures.
2. Production of and maintenance of construction model.
3. Coordination drawings.
4. As-built model turn over.

B. Related Sections:

1. Division 01 Section 01 31 00 "Construction Schedules" for preparing and submitting Contractor's construction schedule.
2. Division 01 Section 01 31 19 “Project Management and Coordination” for general coordination provisions.
3. Division 01 Section 01 31 20 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
4. Division 01 Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.
5. Division 01 Section 01 78 39 “Project Record Documents” for coordination of closeout deliverables.
6. Division 05 and 21-32 Sections for scopes of work which are required to be incorporated into the construction model for coordination purposes.

1.3 DEFINITIONS

A. BIM: Building Information Model, a database of construction project information which is most commonly expressed in 3D geometrical information, but can include schedule, cost loading, and maintenance and operation data, as well as wholly textual or numeric information.

B. Level of Development (LOD): Articulated in AIA G202, general levels of detail and information richness of model elements corresponding to intended use and stage of planning, design, or pre-fabrication. LOD refers to the development of elements which are indicated to be included.

C. Design Model: The 3D model provided by the Architect and/or consultants from which the Contract Documents have been rendered. Disposition of the model is purely to create the Architect’s Instruments of Service and is not a Contract Document. Transmittal of model must be preceded by Hold Harmless Release.

D. Construction Model: The Contractor’s living BIM model, usually founded on the design model but including more detailed systems information, additional modeling of elements not included, modification of elements to align with Contractor’s means and methods, and generally being more complete and detailed to support Contractor’s operation. When submitted for demonstration of contractual obligation to coordinate, this model is referred to as the coordination model.

E. Coordination Deliverables: Digital data which demonstrate that the required coordination has been undertaken, usually including both a BIM model of all required systems and coordination drawings, which consist of 2D drawings of overlaid systems and penetration drawings and other important interfaces between required systems drawn from the coordination model.

F. BIM Coordinator: An employee or consultant of the General Contractor, possessing a minimum of 7 years of experience creating Building Information Models, including management of models, and preparing of Clash Detection reports.

1.4 SUBMITTALS

A. Major Clash Coordination Model: Upgraded model for LOD requirements, means and methods, shop standards, constructability, full populated with model elements so as to illuminate all major coordination issues. Mains, trunks, and all major elements should be resolved as to position, or pending instruction from designer for resolution of positions.

B. Clash Free Coordination Model: Further refined version of the Major Clash Coordination Model to a s fully clash-free state between all runouts, branches, drops, etc.

C. Coordination Drawings: Digital or paper prints with overlaid services and regular section cuts in the densest areas, including slab penetration and structural member penetration drawings. Coordination drawings shall not replace Shop Drawings required by individual Sections.

D. Construction Model updates: Submitted not less than monthly, concurrent with Pay Applications, or maintained continuously online.

E. As-built Model: Digital submission of upgraded and enhanced-detail design model, comprising the BIM representation of all constructed physical elements. Refer to Division 01 ‘Project Record Documents.’

1.5 QUALITY ASSURANCE

A. Level of Development Standard: BIMForum’s most recent version shall govern, see bimforum.org/lod/

B. Software: BIModels should be prepared and tested by the following or equal:

1. Authoring: AutoDesk Revit.
2. Clash Resolution: Navisworks Manage.

C. BIM Execution Plan Meeting: Prior to the starting of coordination and development of models, the Contractor shall host a modeling implementation to review protocols and procedures. Discussion should include the following:

1. Schedule, including deadlines for shop drawing preparation and fabrication
2. Software of various stakeholders.
3. Hierarchy for clash resolution and precedence.
4. Preliminary strategies for routing, including stratification of work for each trade.
5. Layering and color conventions.
6. Procedures for maintenance of a living Construction Model.
7. Collaboration protocol and procedures.
8. Identification of BIM Lead for each trade.
9. Color coding for each trade, and shared coordinate system.
10. Discussion of Level of Development and to what degree models may be relied upon by other trades.

1.6 COORDINATION, GENERAL

A. Coordination: Coordinate construction operations included in different Sections of the specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Preliminary BIM coordination has been undertaken during the design phase in order to eliminate major issues only; no representation is made to the efficacy of that coordination.

1.7 COORDINATION MODEL AND DRAWINGS

A. Coordination Deliverables, General: The construction model is to be created, updated, and detailed for preparation of coordination drawings and for submittal itself when indicated by individual Sections, and under the following circumstances:

1. Where installation is not completely shown on Shop Drawings
2. Where limited space availability necessitates coordination
3. If coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

B. Construction Model Organization: Contractor shall produce a BIM model in sufficient detail to adequately explore and document conditions in the building to avoid interference between structural framing, ceilings and wall partitions, major equipment, mechanical, electrical, conveying systems, and other engineer service systems. The following elements must be included in the Construction Model at the time of its initial submittal for coordination, and to the following levels of development as a minimum for each segment of construction indicated, as generally interpreted in the industry and below:

1. LOD 500: The Model Element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Elements.
2. LOD 400: The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.

    a. Complete steel structural system including:

        1) Major columns and beams and associated connection materials.
        2) Braces and frames, including turnbuckles.
        3) Gusset plates, pour stops,

    b. HVAC system elements as follow:
    c. All Ductwork.

3. LOD 350: The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, orientation, and interfaces with other building systems. Repetitive elements are modeled in their actual positions. Non-graphic information may also be attached to the Model Element.

    a. Plumbing system including:

        1) Domestic water piping for service, sanitary, storm and vent.

2) Plumbing fixtures.
3) Water storage tanks.
4) Sewerage and storm-water equipment and drains.
5) Compressed air systems.

b. HVAC system including:

1) Registers and Grilles.
2) Air handling units, chillers, fan coil units, VAVS, and all major equipment.
3) Fire and smoker dampers.
4) Hangers associated with required equipment.
5) Fuel piping and storage tanks.
6) Heat generating equipment.

c. Electrical system including:

1) All conduit ¾" in diameter and above.
2) Service panels, meters, substations, transformers, switchgear and protective devices.
3) Light fixtures.
4) Receptacles and switches.
5) Generators and other equipment.
6) Lightning protection.

d. Special systems.
e. Fire protection systems including:

1) Sprinkler mains, branches, drops and heads.
2) Pumps, risers, valves.
3) Fire protection cabinets and specialties..

4. LOD 300: The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

a. Other structural elements, including concrete and non-steel elements.
b. Conveying systems including:

1) Elevator cabs, support rails, hoist beams and doors.
2) Escalators.
3) Service systems including electrical and mechanical.
4) Mechanical room equipment.
5) Special foundation elements, including pits and anchoring.

c. Site systems including:

1) Site utilities.
2) Storm drainage piping and structures.
3) Sanitary drainage piping and structures.
4) Services to building, such as electric mains, water and sprinkler services, gas lines etc.

d. Communication systems including:

1) Panels and equipment.
2) Cable trays, grouped wiring runs, and conduit runs.
3) Receptacles.

e. Specific Elements in a Digital Mock-up of typical rooms configurations.

1) Medical equipment.
2) Large prefabricated equipment.
3) Ceiling cubicle tracks and other accessories intruding into the plenum and wall space.

5. LOD 200: The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

a. All construction model elements not otherwise provided for.

6. LOD 100: The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.

C. File Format and Software: Submitted models should be in Autodesk Revit file format. Individual trades may model in other software at their choice provided that their geometry can be converted into Revit format. Major equipment should be included as a native Revit family for future virtual facilities management purposes.

1. Clash resolution may be performed via any suitable software program, provided it generally matches Autodesk Navisworks in performance of physical interference between geometries.

D. Coordination Drawings: Construction model-derived 2D drawings, drawn accurately to a scale large enough to indicate and demonstrate the resolution of conflicts. Do not base coordination drawings on standard printed data that has not been incorporated into the model. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
e. Indicate required installation sequences.
f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

E. Coordination Drawing Organization: Organize coordination drawings as follows, as required to demonstrate coordination process.

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Review: Architect will review submitted construction model and coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Architect determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Architect will so inform the Contractor, who shall make changes as directed and resubmit.

    a. Submittal: Coordination Drawings must be submitted concurrently with the first set of shop drawings of any trade or Section which is to be coordinated by the individual drawings.

7. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 01 Section "Submittal Procedures."

1.8 COORDINATION MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated, with provisions for non-local participants to observe via suitable web-meeting software or service.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within five days of the meeting.

B. Coordination Conferences: Schedule and conduct conferences to resolve clashes between services for each subdivision of the documents.

1. Attendees: Contractor’s Project Manager and/or superintendent, BIM manager/MEPFP coordinator, major subcontractors; suppliers;; shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to their respective scope of the Work.
2. Major clash conferences: Develop and adopt major coordination strategies at multi-trade or significant systemic clash groups.
3. Round-out Clash conferences: Resolve outstanding clash issues and review all issues preventing creation of a clash-free model.

C. Initial Coordination Review Conference: Schedule and conduct a major-clash coordination conference to review the initial model submission not more than 90 days from the Notice to Proceed.

1. Conduct the conference to review major coordination issues and RFI issues for the construction team to resolve.
2. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference.

1.9 SPECIAL EQUIPMENT AND PERSONNEL

A. Computer Hardware and Display: Maintain onsite one computer of capability sufficient to handle model viewing program and monitor display for use to examine and analyze current state of construction model.

B. BIM Manager/MEPFP Coordinator: Provide one member of staff or subcontracted entity to manage BIM model and facilitate clash resolution.

1. Manager/Coordinator to be primarily dedicated towards resolution of MEPFP coordination issues and examination of model for potential mutually–disadvantageous situations requiring clarification from the Architect until final coordination model is accepted without exception by the Architect. BIM Manager should not have other high-priority or overriding role on site which would prevent the performance of these duties, but is not required to be on site full time.

1.10 CONSTRUCTION MODEL AND AS-BUILT SUBMITTAL

A. Construction Model Modifications: Following acceptance of a clash-free model submission for coordination, the Construction Model shall be maintained and updated not less than bimonthly with any modifications incorporated into the Work and maintained online or at project site for access by the Contractor, Architect, Program Manager, or Owner during meetings for reference.

1. Contractor to produce complete construction model to a minimum of LOD 200, with elements indicated to have higher LODs indicated elsewhere, to comprise the as-built model. Contractor may use the design model and infill model elements which are lacking to produce the complete model. Contractor shall have no claim in case of omission of model/building components in the design model which would be reasonably required to represent competed construction, and the design model is provided as a convenience for the Contractor.
2. Contractor and all subcontractors to receive and utilize design model must execute a hold-harmless agreement acknowledging their understanding of the design model as exterior to the contract, delivered as is with no representation of accuracy or completion, and to be reasonably cross referenced with the Contract.

B. Required updates to the model:

1. Construction Change Directives (CCDs)
2. Architect's Supplemental Information documents (ASIs)
3. Proposal Requests, once change in costs and duration changes are agreed upon.
4. Request for Information (RFIs) replies.
5. Shop Drawings review comments.
6. Bulletins.
7. Field changes and changes made to geometry and layout due to means and methods, constructability, etc.

C. Close-out Submission: Concurrent with other close-out submissions, contractor shall turn over full construction model. Refer to Section "Close-out Procedures" for more details.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 13

SECTION 01 31 14 - COORDINATION COMMISSIONING AGENT AND GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 COMMISSIONING

A. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in Section 01 91 13, Part 1.4. The commissioning process, which the Contractor is responsible to execute, is defined in Division 01. The commissioning process will be directed by a Commissioning Authority whose services will be provided by the Architect.

B. Abbreviations. The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan.* Definitions are found in Section 01 91 13, Part 1.6.

A/E-	Architect and design engineers	FT-	Functional performance test
CxA-	Commissioning Authority	GC-	General contractor (prime)
CC-	Controls contractor	MC-	Mechanical contractor
CM-	Construction Manager (the Owner's representative)	PC-	Pre-functional checklist
Cx-	Commissioning	PM-	Project manager
Cx Plan-	Commissioning Plan document	Subs-	Subcontractors to General
EC-	Electrical contractor	TAB-	Test and balance contractor

1.2 ADMINISTRATIVE / SUPERVISORY PERSONNEL

A. Commissioning Authority: the Owner will provide the services of a qualified Commissioning Authority. The Commissioning Authority directs and approves the commissioning work.

END OF SECTION

SECTION 01 31 19 - PROJECT MEETINGS

PART 1: GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections apply to this Section.

1.2 SUMMARY:

A. This Section specified administrative and procedural requirements for project meetings including, but not limited to:
   1. Pre-Construction Conference
   2. Progress Meetings

B. Construction Schedules are specified in SECTION 01 33 00: SUBMITTAL PROCEDURES

1.3 PRE-CONSTRUCTION CONFERENCE:

A. Schedule a conference and organization meeting at the Project Site, or other convenient location, no later than 15 days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments. Included in this Conference shall be the Owner, Architect and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers, and other concerned parties shall each be represented at the Conference by persons familiar with and authorized to conclude matters relating to the Work.

B. The purpose of this meeting shall be to discuss items of significance that could affect progress.

1.4 PROGRESS MEETINGS:

A. Conduct progress meetings at the Project Site at two week intervals. Notify the Owner and Architect of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment requests.

B. In addition to representatives of the Owner and Architect, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings by persons familiar with the project and authorized to conclude matters relating to progress.

C. Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the project.

D. Provide current record drawings and project manual at each construction meeting.

E. Provide updated RFI and Submittal Log at each meeting.

F. Schedule Updating:

1. Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

PART 2: PRODUCT (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 20 - PROJECT COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

Section Includes: Requirements for project coordination including but not necessary limited to:

1. Construction activities.
2. Submittals.
3. Requests for Information (RFI).
4. Record Drawings.
5. General installation provisions.
6. Cleaning and protection.

Related Sections:

7. Section 01 11 00 – Summary
8. Section 01 31 00 –Construction Schedule
9. Section 01 77 00 –Closeout Procedures

1.2 CONSTRUCTION ACTIVITIES

Coordination: Coordinate and schedule activities (including submittals, testing, and preparations to assure efficient and orderly installation of each part of the Work

1. Sequence activities to obtain the best installation and in-place performances.
2. Coordinate installation of components to assure adequate accessibility for installation, maintenance, service, and repair.
3. Make necessary provisions for items scheduled for later installation under the Contract and by separate contractors.
4. Schedule product deliveries to assure continuity and proper sequence of operations, without delay and interruptions.
5. Verify that equipment items are suitable for available mechanical and electrical systems.

Communications: Where necessary, distribute instructions for coordination.

6. Prepare and issue memoranda for the Owner and separate contractors where coordination of their work is required.

Administrative Procedures: Coordinate administrative activities with construction to avoid delays and assure orderly progress of the Work. Such activities include, but are not limited to, the following:

7. Preparation of schedules.
8. Installation and removal of temporary facilities.
9. Delivery and processing of submittals.
10. Project closeout activities.

1.3 SUBMITTALS

Staff Names: Within fifteen (15) days after Notice to Proceed, submit a list of Project Staff assignments, with individual names, their assignments, and telephone numbers.

1.4 REQUESTS FOR INFORMATION (RFI)

A. **RFI Software Platform:**

1. RFI's (Requests for Information) shall be processed through the Architect's software program - Autodesk "Build". Contractor will have access to this software at no charge to the Contractor and shall be required to utilize this software for all RFI's.

2. The Contractor shall plan for this process accordingly with regard to their project operations.

3. Architect will provide initial introduction to and some basic training on the system to the Contractor's project team.

B. **General:**

1. Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

2. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.

3. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

C. **Content of the RFI:**
Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. Project number.

3. Date.

4. Name of Contractor.

5. Name of Architect.

6. RFI number, numbered sequentially.

7. RFI subject.

8. Specification Section number and title and related paragraphs, as appropriate.

9. Drawing number and detail references, as appropriate.

10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

12. Contractor's signature.

13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

D. **Forms:**

1. Contractor's own software-generated form with substantially the same content as indicated above, acceptable to Architect or direct input to Architect's software identified above are acceptable.

2. Attachments shall be electronic files in Adobe Acrobat PDF format.

3. **Mass RFI's:** Receipt of 10 or more RFI's within a seven-day period will result in additional time allowed by the Architect for response. The Architect is allowed an additional fourteen days for every 10 RFI's submitted in a seven-day period.

4. **Architect's Action:** Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

5. The following Contractor-generated RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for approval of Contractor's means and methods.
   d. Requests for coordination information already indicated in the Contract Documents.
   e. Requests for adjustments in the Contract Time or the Contract Sum.
   f. Requests for interpretation of Architect's actions on submittals.
   g. Incomplete RFIs or inaccurately prepared RFIs.

6. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.

7. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. **RFI Log:**

1. Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Software log with not less than the following:
   a. Project name.
   b. Name and address of Contractor.
   c. Name and address of Architect.
   d. RFI number including RFIs that were returned without action or withdrawn.
   e. RFI description.
   f. Date the RFI was submitted.
   g. Date Architect's response was received.

F. **Distribution and Follow-up:**

1. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

2. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

3. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

Visual Effects: Provide uniform joint width in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

3.2 CLEANING AND PROTECTION

During Handling and Installation: Clean and protect construction in progress and adjoining materials in place.

1. Apply protective covering where necessary to ensure protection from damage or deterioration at Substantial Completion.
2. Clean and maintain completed construction through the remainder of the construction period.

Limiting Exposures: Supervision construction activities to ensure that no part of the construction, completed or in progress, is subject to excessive loading, damaging temperature and humidity extremes, staining, contact between incompatible materials and similar harmful and deteriorating exposure during the construction period.

Repair and Replacement: If any parts of the construction are deteriorated, become damaged, develop defects, or are otherwise not in compliance with requirements of the Contract, they shall be cleaned, restored to proper condition, repaired acceptably, or replaced with new products prior to requesting Architect's inspection for Substantial Completion or Final Completion.

END OF SECTION 01 31 20

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.
4. Periodic aerial photographs.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
B. Digital Photographs: Submit image files within three days of taking photographs.

1. Digital Camera: Minimum sensor resolution of 8 megapixels.
2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
3. Identification: Provide the following information with each image description in file metadata tag:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.
B. Aerial photographer’s qualifications: A firm which has been regularly engaged to document construction professionally for not less than three years.

1.5 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 -PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 -EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Available Photographic Service: Provide photographic services by Multivista Construction Documentation, or a comparable photographic service or photographer with suitable support, to provide a service comparable to the packages offered via their Exterior Progression and Interior Progression services.

    1. Photographic service to integrate seamlessly with project website, providing for uploaded, organized photographs keyed to locations within 24 hours of regular site visits.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

    1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

    1. Date and Time: Include date and time in file name for each image.
    2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.

D. Neighborhood Inspection Plan: Incorporate Owner's Neighborhood Inspection requirements in submittal of preconstruction, periodic construction, and final completion construction photographs.

E. Preconstruction Photographs: Before commencement of excavation, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

    1. Flag construction limits before taking construction photographs.
    2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
    3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
    4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements. See specifications Section 31 62 19 “Timber Piles” for additional information concerning Neighborhood Inspection Plan and Damage to Existing Property requirements.

F. Periodic Construction Photographs: Take 50 photographs bi-weekly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

G. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

H. Final Completion Construction Photographs: Take 50 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.

    1. Do not include date stamp.

I. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

    1. Three days' notice will be given, where feasible.
    2. In emergency situations, take additional photographs within 24 hours of request.
    3. Circumstances that could require additional photographs include, but are not limited to, the following:

        a. Immediate follow-up when on-site events result in construction damage or losses.
        b. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
        c. Substantial Completion of a major phase or component of the Work.

J. Aerial Photographs: Not less than three photographs of site from oblique angles, taken monthly, selected to illustrate greatest amount of building possible from different perspectives. Monthly photographs are to be from as close as to the same position as possible, and continue through Substantial Completion

END OF SECTION 01 32 33

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

E. Mass Submittals: Mass submittals are considered those submittals that are a specified number or greater of submittals provided to the design team within a certain time frame and/or a submittal

or specific set of submittals that are extremely large in the number of items included for review or complex in nature of the submittal that would require additional time and effort for the design team to complete and return the submittal.

1.4 SUBMITTAL SOFTWARE

A. All submittals shall be submitted through the use of the Architect's provided software, Autodesk Build.

1. Service is a web based software system and is of no cost to the Contractor.
2. Basic training and introduction to the system will be provided by AQ Studios personnel and resources from Autodesk when needed.
3. Physical samples shall be logged in to the software system with the actual samples and a copy of the submittal cover sheet sent directly to the Architect.
4. No other software systems for which the Contractor may possess are to be used for submittals without specifically being agreed to in advance between Owner, Architect, and Contractor.

1.5 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled date of fabrication.
    h. Scheduled dates for purchasing.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.6 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings may be provided by Architect for Contractor's use in preparing submittals.

1. Architect may furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
    a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD and / or Revit depending upon the project..
    c. The following digital data files will by furnished for each appropriate discipline:
        1) Floor plans.
        2) Reflected ceiling plans.
2. Electronic files available to the Contractor will only be those deemed appropriate by the Architect and will be contingent upon the Contractor signing an agreement generated by the Architect. The Architect will be the sole judge of what files are deemed appropriate.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
5. Mass Submittals: Receipt of 10 or more submittals within a 7 day period will result in additional time allowed by the Architect for response. The Architect is allowed an additional 14 days for every 10 submittals submitted in a 7 day period. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
    a. Mass Submittals in Number: Receipt of 10 or more submittals within a 7 day period will result in additional time allowed by the Architect for response. The Architect is allowed an additional 14 days for every 10 submittals submitted in a 7 day period. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
    b. Mass Submittals in Size and Complexity: Receipt of submittals of a particularly large and/or complex nature either separately or in part with other submittals will automatically result in additional time allowed by the Architect for response. The Architect is allowed an additional 14 days for every 10 submittals submitted in a 7

day period. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1) Submittals of a particularly large and complex nature are typically inclusive of but not limited to Door Hardware, Electrical submittals, lighting submittals, steel submittals, and others requiring multiple disciplines detailed reviews.

6. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
7. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
8. Resubmittal Review: Allow 15 days for review of each resubmittal.
9. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
10. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

C. Paper Submittals: Note Paper Submittals (hard copies) are not allowed unless otherwise indicated by the Architect and on a limited basis. When allowed paper submittals shall follow the following:

1. Place a permanent label or titleblock on each submittal item for identification.
2. Indicate name of firm or entity that prepared each submittal on label or title block.
3. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
4. Include the following information for processing and recording action taken:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of subcontractor.
   g. Name of supplier.
   h. Name of manufacturer.
   i. Submittal number or other unique identifier, including revision identifier.
      1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
   j. Number and title of appropriate Specification Section.
   k. Drawing number and detail references, as appropriate.
   l. Location(s) where product is to be installed, as appropriate.
   m. Other necessary identification.
   n. Clearly highlighted and noted identification of materials, models, colors, etc. being submitted. DO NOT just submit data that is not clearly highlighted identifying the exact submittal or submittals within the documentation.

5. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
    a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect. Additional copy shall have the same requirements for submittal as the original. If additional copy does not follow the same requirements the entire submittal may be rejected for correction and resubmission.
6. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
    a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
        1) Project name.
        2) Date.
        3) Destination (To:).
        4) Source (From:).
        5) Name and address of Architect.
        6) Name of Construction Manager.
        7) Name of Contractor.
        8) Name of firm or entity that prepared submittal.
        9) Names of subcontractor, manufacturer, and supplier.
        10) Category and type of submittal.
        11) Submittal purpose and description.
        12) Specification Section number and title.
        13) Specification paragraph number or drawing designation and generic name for each of multiple items.
        14) Drawing number and detail references, as appropriate.
        15) Indication of full or partial submittal.
        16) Transmittal number.
        17) Submittal and transmittal distribution record.
        18) Remarks.
        19) Signature of transmitter.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner,containing the following information:
    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Names of subcontractor, manufacturer, and supplier.

h. Category and type of submittal.
i. Submittal purpose and description.
j. Specification Section number and title.
k. Specification paragraph number or drawing designation and generic name for each of multiple items.
l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Related physical samples submitted directly.
o. Indication of full or partial submittal.
p. Transmittal number.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via Architect's software program and as PDF electronic files.
   a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.
   i. Clearly highlighted and noted identification of materials, models, colors, etc. being submitted. DO NOT just submit data that is not clearly highlighted identifying the exact submittal or submittals within the documentation.
4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
   a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.

c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:
   a. PDF electronic file.
   b. Reduce pdf file size as much as possible.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.
   e. Specification paragraph number and generic name of each item.
3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
   a. PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

1. All submittals not marked as reviewed by the Contractor will be returned without action.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Reviewed
2. Furnish as Corrected
3. Revise and Resubmit
4. Rejected
5. Not Required for Review

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

SECTION 01 33 01 - SUBMITTALS – COMMISSIONING

PART 1 – GENERAL

1.1 SUBMITTAL REQUIREMENTS FOR COMMISSIONING:

A. Normal Submittals.

1. The Commissioning Authority will receive a copy of the normal submittals for equipment to be commissioned.

2. The Commissioning Authority will review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.

B. Data for Commissioning.

1. The Contractor will receive a written request from the Commissioning Authority requesting specific information needed about each piece of commissioned equipment or system.

2. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority.

3. The Commissioning Authority may request further documentation necessary for the commissioning process.

4. This data request may be made prior to normal submittals.

5. Much of this information is contained in the regular O&M manual submittals normally submitted in the project. Typically, this information is required prior to the regular formal O&M manual submittals.

C. Contractor's responsibility for deviations in submittals from requirements of the Contract Documents is not relieved by the Commissioning Authority's review.

END OF SECTION

SECTION 01 35 73 DELEGATED DESIGN REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies the procedures and requirements for Contractor's delegated design responsibilities for specific building systems or components as identified in the Contract Documents.

B. Delegated design includes, but is not limited to, the engineering and preparation of drawings, calculations, and other documents by a qualified, licensed design professional retained by the Contractor.

1.02 RELATED SECTIONS

A. General Conditions and Supplementary Conditions

B. Division 01 Section 01 33 00 "Submittal Procedures"

C. Division 01 Section 01 40 00 "Quality Requirements"

1.03 SUBMITTALS

A. Delegated Design Submittals: Submit the following in accordance with Section 01 33 00 "Submittal Procedures":

1. Shop Drawings: Include all details, materials, dimensions, attachments, interfaces, and configurations. Drawings shall be sealed by a licensed Professional Engineer registered in the jurisdiction of the project.
2. Structural Calculations: Provide sealed calculations demonstrating conformance to performance criteria, code requirements, and applicable design loads.
3. Coordination Drawings: Indicate relationships and interfaces with adjacent work.
4. Certificate of Professional Qualification: Include name, license number, and state of registration for the engineer of record responsible for the delegated design.

1.04 QUALITY ASSURANCE

A. Design Professional Qualifications:

1. A Professional Engineer (PE) currently licensed in the state where the project is located.
2. Experienced in design and detailing of the delegated systems.

B. Review by the Architect/Engineer of Record is for general conformance only and does not relieve the Contractor or their retained engineer of responsibility for full compliance with codes and performance criteria.

C. Delegated design documents shall meet all applicable codes, standards, and specific performance requirements identified in the Project Manual and Drawings.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

3.01 COORDINATION

A. The Contractor shall coordinate delegated design systems with adjacent materials and systems.

B. Notify the Architect of any conflicts between delegated design requirements and other elements of the project.

C. Incorporate field-verified dimensions and actual conditions into the delegated design prior to submission.

3.02 INSTALLATION

A. Install systems in accordance with approved delegated design documents and applicable codes.

B. Installation shall comply with sealed drawings and the manufacturer’s recommendations.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:
   1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
   2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect

C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Contractor's Quality-Control Manager Qualifications: For supervisory personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.
   1. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
   1. Project quality-control manager shall not have other Project responsibilities.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring testing or inspection, including the following:
   1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
   3. Owner-performed tests and inspections indicated in the Contract Documents

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329 and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
      f. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect
   2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
      a. Allow seven days for initial review and each re-review of each mockup.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed, unless otherwise indicated.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
   3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
   4. Owner shall engage and pay for testing and inspection services for the following:
      a. Soil and geotechnical testing and inspection.
      b. Concrete testing, including slump, air content, temperature, cylinders and compressive-strength tests.
      c. Structural-steel and weld inspection and testing.
      d. Special inspections required by the Building Code or authorities having jurisdiction.
   5. Independent commissioning agent is contracted by Owner. Contractor is required to perform and coordinate all Commissioning responsibilities as described in the Commissioning Spec Sections.,

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of the Contractor's quality-control plan]. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses. .
   1. Distribution: Distribute schedule to Owner, Architect testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction as the responsibility of Owner, as indicated in individual specifications sections, and as follows:
   1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
   3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
   5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
   6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	American Concrete Institute www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000

AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)	
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300

ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
AWCI	Association of the Wall and Ceiling Industry www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
BWF	Badminton World Federation (Formerly: IBF - International Badminton Federation) www.internationalbadminton.org	6-03-9283 7155

CCC	Carpet Cushion Council www.carpetcushion.org	(610) 527-3880
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet and Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	Canadian Standards Association	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Cast Stone Institute www.caststone.org	(717) 272-3744
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau	(604) 820-7700

	www.cedarbureau.org	
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA) www.intertek.com	(800) 967-5352
FIBA	Federation Internationale de Basketball (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.ch	41 21 345 35 35
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FM Global)	
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440

GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Part of GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
IBF	International Badminton Federation (Now BWF)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426

ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA (Now ETL SEMCO)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(888) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926

NAGWS	National Association for Girls and Women in Sport www.aahperd.org/nagws/	(800) 213-7193, ext. 453
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)	(901) 526-5016

	www.nofma.com	
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. (Now ITS)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America) www.landcarenetwork.org	(800) 395-2522 (703) 736-9666
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.redwoodinspection.com	(888) 225-7339 (415) 382-0662
SAE	SAE International	(877) 606-7323

	www.sae.org	(724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333

SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. (Now TCNA)	
TCNA	Tile Council of North America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943

WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
UBC	Uniform Building Code (See ICC)	

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://.dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration	(888) 463-6332

	www.fda.gov	
GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service (See GSA)	
PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board http://gulliver.trb.org	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664

DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
	Available from Defense Standardization Program www.dps.dla.mil	
	Available from General Services Administration www.gsa.gov	(202) 619-8925
	Available from National Institute of Building Sciences www.wbdg.org/ccb	(202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
MIL	(See MILSPEC)	
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF	State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation www.dca.ca.gov/bhfti	(800) 952-5210 (916) 574-2041
CCR	California Code of Regulations www.calregs.com	(916) 323-6815
CPUC	California Public Utilities Commission www.cpuc.ca.gov	(415) 703-2782
TFS	Texas Forest Service Forest Resource Development http://txforestservice.tamu.edu	(979) 458-6650

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections:

1. Division 01 Section 01 10.00 "Summary" for work restrictions and limitations on utility interruptions.
2. Refer to Civil Documents for "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.

1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

C. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of the work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air filtration system discharge.
4. Other dust-control measures.
5. Waste management plan.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete bases for supporting posts.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils minimum thickness, with flame-spread rating of 15 or less per ASTM E 84.

C. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

D. Plywood: Water preservative treated in accordance with AWPA UIUse Category UC4a

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect and construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
3. Drinking water and private toilet.
4. Coffee machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

2.4 HURRICANE PREPAREDNESS PLAN

A. Within thirty (30) days of the Notice to Proceed, prepare and submit a comprehensive hurricane preparedness plan, detailing emergency contacts in case of a hurricane emergency, with numbers and emails, with detailed plans for the following:

1. Partial site demobilization, including procedures for disassembly of site crane.
2. Protection of in-place work.
3. Enclosure of existing building.
4. Debris removal efforts verification.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Division 01 10 00 Section "Summary."
2. All systems, including electrical, mechanical, smoke detection, plumbing and others, are to be kept in operation at all times. Contractor to allow for any overtime work in connection with weekend or overnight work for work requiring utility interruptions."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

2. All systems, including electrical, mechanical, smoke detection, plumbing and others, are to be kept in operation at all times. Contractor to allow for any overtime work in connection with weekend or overnight work for work requiring utility interruptions

B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

F. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.

1. Provide additional telephone lines for the following:

a. Provide a dedicated telephone line for each facsimile machine in each field office.

2. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Architect's office.
e. Engineers' offices.
f. Owner's office.
g. Principal subcontractors' field and home offices.

3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
b. Adobe Reader 7.0 or higher.
c. WinZip 7.0 or higher.

3.3 SUPPORT FACILITIES INSTALLATION

A. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

B. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

C. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.
b. Egress signs shall read as follows: ‘PLEASE PARDON THE INCONVENIENCE. IMPROVEMENTS ARE IN PROGRESS TO MAKE THIS AREA MORE COMFORTABLE AND CONVENIENT FOR OUR PATIENTS’

3. Maintain and touchup signs so they are legible at all times.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section 01 73 29 "Execution" for progress cleaning requirements.

E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

F. Temporary Elevator Use: Refer to Division 14 21 23 Sections for temporary use of new elevators].

G. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

H. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section 01 10 00 "Summary."

B. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

C. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

D. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Paint and maintain appearance of walkway for duration of the Work.

E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

F. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
1. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant treated plywood.

a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Insulate partitions to control noise transmission to occupied areas.
4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
5. Protect air-handling equipment.
6. Provide walk-off mats at each entrance through temporary partition.

G. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 are considered defective.
b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

E. Physician Tower Regulations: Contractor shall adhere to the facility rules, especially rules concerning hallway cleanliness. Contractor shall work closely with the Project Manager to cause a minimum amount of disturbance and inconvenience to the Hospital patients and visitors.

1. Tobacco Products of all kind are not permitted anywhere on the owner's grounds. This means any patient floor, public hallway, public elevator, stairwell, laboratories, job sites, parking lots, etc.; all shall be non-smoking areas.
2. The hospital cafeteria is set up to serve hospital employees having a half hour lunch break. Outside personnel cause delays in the serving line and employees are consequently late returning to their jobs. All contractors' personnel are advised to eat in the Snack shop or off site.

3.7 PROTECTION OF EXISTING FACILITIES

A. Housekeeping: Contractor shall remove all waste materials and trash from areas affected by new construction and shall keep the area clean and free of such debris to the satisfaction of the Owner and Project Manager.

1. Removal: All debris transported inside the hospital, including corridors and elevators, shall be in a covered cart equipped with rubber tires.
2. Disposal: All contractors are advised that hospital-leased dumpsters on the campus are not to be used for disposal of refuse of any kind. Debris resulting from work may not be stored on hospital campus. Such debris must be removed daily and disposed of off the owner's grounds.

B. Demolition, Removal, And Salvage: All light fixtures, electrical panels, A/C diffusers, coils, plumbing fixtures, sinks, valves, piping, carpet, and other existing usable materials shall be inspected by the Project Manager before disposal. All existing usable material shall either be disposed of or delivered to the Hospital's Engineering and Maintenance Shop at the request of the Project manager.

1. Protection: All exhaust and return air grills are to be covered, taped, and sealed during demolition. Covers are to be removed when work is completed in the evening and reinstalled each day when demolition begins. Constructions to maintain a negative air pressure in order to contain 'Debris Dust.'
2. Personnel Protection: Adequate respiratory aids and eye protection are to be used by Contractor's personnel during demolition, and in accordance with OSHA Standards.
3. All existing carpet shall be inspected by the Project Manager before disposal. At the Project Manager's request, carpet is to be either disposed of or delivered to the Engineering and Maintenance Shop in the Hospital.

C. Fire Safety And Protection: Cutting, burning, and welding will require a permit from the Security Department near the Emergency Room. It also requires advance notice to the Engineering Department to take the area smoke detectors out of service. A fire watch must be maintained by contractors and a suitable fire extinguisher (furnished by the Contractor) must be readily available.

1. Partitions: All new walls shall be built floor to underside of slab. All new and existing walls shall be extended to underside of slab. All such work above ceilings shall be a minimum one layer 5/8" fire rated gypsum board each side, taped and sealed as required, fire-caulked at slab and/or masonry, minimum stud size 3-5/8", wallboard joints staggered and attached with long dimension in a horizontal attitude with screw.
2. Repairs: Contractor shall repair all fire partitions that have been penetrated as part of the construction.

D. Work In Below Floor Slabs: Where execution of the work affects the space below the work location (such as cutting openings in floor slabs, piping, or conduit changes, and additions, and similar operations), schedule and coordinate the performance of the work in advance with the Owner.

1. Related Work: Include the removal and reinstallation of ceiling finishes, light fixtures, pipes, ducts, conduit, and other construction below the floor as necessary to perform the work.
2. Protection: Provide and maintain suitable protection for the building and the Owner's property located on the lower floor.

END OF SECTION 01 50 00

SECTION 01 60 00 – MATERIALS AND EQUIPMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. MATERIALS

1. All materials to be incorporated into the Work shall be new, unless indicated otherwise by the Contract Documents.
2. Materials shall be shipped to the site in manufacturer's unopened containers, where applicable, and checked against requirements of Contract Documents as being applicable for the project.
3. Materials shall be properly stored on site, or elsewhere per subparagraph 9.3.2 of the General Conditions, in such a manner as to protect from adverse weather conditions which may damage or affect its quality.
4. Materials not intended for this project, per requirements of the Contract Documents, or not properly stored prior to installation, shall not be incorporated in the Work.

1.2 EQUIPMENT

A. Contractor, subcontractors, and sub-subcontractors shall provide all necessary tools, equipment apparatus, and machinery necessary to properly carry out the work proficiently.
B. All equipment shall be maintained in a good working order to avoid delays due to any equipment failure.
C. Lack of appropriate equipment shall not relieve the Contractor from specific performance of this Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Sections:

1. Division 01 Section 01 33 00 "Submittal Procedures" for submitting surveys.
2. Division 01 Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Mechanical systems piping and ducts.
    f. Control systems.
    g. Communication systems.
    h. Conveying systems.
    i. Electrical wiring systems.
    j. Operating systems of special construction.
    k.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Equipment supports.
    e. Piping, ductwork, vessels, and equipment.
    f. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities,mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."

E. NOT USED.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat

over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Utilize containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section Temporary Facilities and Controls. And Division 01 Section 01 74 19 "Construction Waste Management and Disposal.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section 01 78 24 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section 01 40 00 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. NOT USED

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

SUMMARY

B. Section includes administrative and procedural requirements for the following:
   1. Disposing of nonhazardous demolition and construction waste.

DEFINITIONS

C. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

D. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

E. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

F. Salvage: Recovery construction waste and subsequent sale or reuse in another facility.

G. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

PERFORMANCE REQUIREMENTS

H. No recycling or salvage is required unless otherwise noted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.

B. Related Sections:
   1. Division 01 Section 01 73 29 "Execution" for progress cleaning of Project site.
   2. Division 01 Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Division 01 Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 01 Section 01 79 00 "Demonstration and Training" for requirements for instructing Owner's personnel.
   5. Divisions 02 through 32 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
   5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   7. Complete startup testing of systems.
   8. Submit test/adjust/balance records.
   9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   10. Advise Owner of changeover in heat and other utilities.
   11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   12. Complete final cleaning requirements, including touchup painting.

13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
   2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems Submit demonstration and training video recordings.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Contractor shall provide cloud-based punch-list reporting, organization, and clearance system, such as Plangrid.
   1. Organize list of spaces in sequential order
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3.
   4. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect
      d. Name of Contractor.
      e. Page number.
   5. Submit list of incomplete items in the following format:
      a. PDF electronic file.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Format for Lists:

1. Warranties and Bonds: Provide two (2) original signed documents where warranties and bonds are required under individual Sections. Unless otherwise required in the individual product or installation Section, provide manufacturer's, supplier's, or subcontractor's standard form.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section 01 50 00 "Temporary Facilities and Controls."

END OF SECTION 01 77 00

SECTION 01 77 13 - PROJECT CLOSE OUT – COMMISSIONING

PART 1 – GENERAL

1.1 PREREQUISITES TO FUNCTIONAL COMPLETION:

A. All TAB work and commissioning must be complete prior to Functional Completion, unless approved in writing by the Owner's Project Manager. Exceptions to this are the planned control system training performed after occupancy and any required seasonal or approved deferred testing. This includes for all systems, but is not limited to:

1. Completed and signed start-up and pre-functional checklist documentation
2. Requested trend log data
3. Submission of final approved TAB report
4. Completion of all functional testing
5. Required training of Owner personnel completed and approved
6. Submission of the approved O&M manuals
7. All identified deficiencies have been corrected or are approved by the Owner to be accepted from this milestone

B. The Owner's Project Manager will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Functional Completion.

END OF SECTION

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals

B. Related Sections:
1. Division 01 Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Divisions 02 through 32 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:
1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Architect.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or modify each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
2. Provide 3 copies to Owner.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

C. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

D. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of operation and maintenance manuals.
   2. Comply with requirements of newly prepared record Drawings in Division 01 Section 01 78 39 "Project Record Documents."

E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 01 78 24 – COMMISSIONING OPERATIONS AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 DESCRIPTION:

A. The commissioning process requires detailed O&M documentation. Division 1 is alerted to the O&M documentation requirements identified in this section, in Section 01 91 13 Commissioning Requirements and other referenced sections.

B. The commissioning agent's contribution to the O&M manuals is found in Section 01 91 13.

C. The GC shall compile O&M manuals for every piece of equipment and building operating or electrical system with the following format.

1. Format: 8 ½" x 11" loose leaf binders. Each binder shall be clearly labeled on the spine. Use as many as required. Do not overload binders. There shall be dividers with permanently marked tabs of card stock separating each section and sub section. Tab labels shall not be handwritten.

2. There shall be a title page and table of contents in the front of each binder for each binder's contents. In each binder, there shall be a main tab for each specification section. Behind the section number tab there shall be the equipment ID tag sub-tab for each piece of major equipment (or group, if small or numerous). These sub-tabs shall be similar to the specification number tabs but of a different color. Behind each equipment name tab shall be the following sections, in the given order, divided by a double weight colored sheet labeled with the title of the section.

a. Contractor. The first page behind the equipment tab shall contain the name, address and telephone number of the manufacturer and installing contractor and the 24-hour number for emergency service for all equipment in this section, identified by equipment.

b. Submittal and Product Data. This section shall include all approved submittal data, cut sheets and appropriate shop drawings. If a submittal was not required for approval, descriptive product data shall be included.

c. Operation and Maintenance Instructions. These shall be the written manufacturer's data with the model and features of this installation clearly marked and edited to omit reference to products or data not applicable to this installation. This section shall include data on the following:

1. Installation, startup and break-in instructions

2. All starting, normal shutdown, emergency shutdown, manual operation, seasonal changeover and normal operating procedures and data, including any special limitations.

3. O&M and installation instructions that were shipped with the unit.

4. Preventative maintenance and service procedures and schedules.

5. Troubleshooting procedures.

6. A parts list, edited to omit reference to items which do not apply to this installation.

7. A list of any special tools required to service or maintain the equipment.

8. Performance data, ratings and curves.

9. Warranty, which clearly lists conditions to be maintained to keep warranty in effect and conditions that would affect the validity of the warranty.

10. Any service contracts issued.

d. Supplemental Data. Prepare written text and/or special drawings to provide necessary information, where manufacturer's standard printed data is not available and information is necessary for a proper understanding and operation and maintenance of equipment or systems, or where it is necessary to provide additional information to supplement data included in the manual or project documents.

e. Control Drawings. Include the control drawings for the piece of equipment and its components, including the sequence of operation. This section will be provided by the controls contractor. The drawings will be repeated in the control contractor's O&M submittals.

f. Specifications. This section is comprised of the component or system specification section copied and inserted complete with all addenda.

g. System Description. This section shall include the individual equipment portion of the overall system Design Documentation Narrative, if available. It will contain simplified professionally drawn single line system diagrams on 8 ½ x 11 or 11 x 17 sheets if the system's control drawing is not adequate.

h. Preventive Maintenance Instructions. This section shall include condensed typewritten excerpts from the manufacturer's written instructions for weekly, monthly, quarterly, annual, etc. maintenance. This summary shall be prepared by the HVAC mechanical contractor with help from the equipment supplier. It shall be prepared for all items listed under condensed operating instructions (below), plus package, window or through the wall AC units and electric unitary heating equipment.

3. Controls and Test and Balance (TAB) O&M Manuals. The controls contractor and TAB contractor have special O&M manual preparation requirements in Section 23 09 00 and 23 05 94 that shall be merged with those of this section.

4. Architect and Design Engineers' Contributions. The architect and design engineers have special contributions to the O&M manuals as described in Section 01 91 13.

5. Commissioning Record and Testing Data. There will be a separate manual dedicated to documenting the commissioning process which will include all certifications and testing data and some repeating of O&M data. Description of this manual is found in Section 01 91 13 and shall be prepared by the commissioning agent.

END OF SECTION

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Miscellaneous record submittals.

B. Related Sections:
   1. Division 01 Section 01 77 00 "Closeout Procedures" for general closeout procedures.
   2. Division 01 Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 03 through 32 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Submit copies of record Drawings for Architect's use as follows:
      a. Submit two paper copies and one set of PDF electronic files of marked-up record prints, Provide each Drawing, whether or not changes and additional information were recorded

B. Record Specifications: Submit two paper copies and one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit two paper copies and annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: For Architect's use in preparing final record documents, maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations below first floor.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.
3. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders**,** record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file, paper copy, and/or scanned PDF electronic file(s) of marked up paper copy of Specifications per documents, and as required by Architect and Owner.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file, paper copy, and/or scanned PDF electronic file(s) of marked up miscellaneous record submittals as prescribed by the Owner.
   1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

B. Related Sections:

1. Divisions 02 through 32 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 INFORMATIONAL SUBMITTALS

A. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

1. Basis of System Design
2. Documentation
3. Emergencies:
4. Operations
5. Adjustments
6. Troubleshooting
7. Maintenance
8. Repairs

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

END OF SECTION 01 79 00

SECTION 01 90 00 – ENVELOPE TESTING AND MOCKUP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for comprehensive exterior envelope testing scope and general quality requirements for quality control mock-up.

B. Related Sections:

1. Refer to Division 01 Section 01 40 00 'Quality Requirements' for testing requirements and other miscellaneous

1.3 ACTION SUBMITTALS

A. Testing Schedule: Within 30 days of NTP, Contractor will submit a preliminary testing schedule, coordinated with Division 01 Section 01 40 00 Quality Requirements and other Sections, alerting Owner and Testing Agency to required presence on site.

1.4 MOCKUP

A. Contractor will construct a full scale exterior mock-up to evaluate aesthetic choices, verify materials, verify installation of envelope materials, and establish a physical reference for quality control. Mock-up will be evaluated and tested successfully prior to construction of the exterior envelope.

B. Contractor shall construct a minimum of 200 sf of both façade materials and back-up envelope construction in full scale to directly mimic all major façade conditions on grade in a location as directed by the Architect. Refer to Drawings for an example of façade area indicated to be constructed. Mockup shall be roughly comparable in the number of details and types of material interactions indicated.

1.5 OWNER'S RESPONSIBILITIES

A. Owner will solicit, retain and pay an independent testing agency to perform tests explicitly required by this and other Sections. Test required by manufacturers are within the Contractor's scope.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall notify Architect. Owner, and Construction Manager not less than 3 weeks of façade substrate enclosure, and shall notify stakeholders and Testing Agency not less than 4 weeks in advance of substrates and locations to be tested to satisfy the requirements of this Section.

B. Contractor shall be responsible for coordinating with testing agency on schedule and availability, prior to enclosure.

1.7 TESTING AGENCY RESPONSIBILITIES

A. Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, Owner and construction Manager and, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

B. All testing reports are to be submitted no more than 1 week following completion of testing.

1.8 COORDINATION

A. Contractor shall notify Owner, Architect, CM and Testing Agency of all required pre-installation conferences, coordination meetings, installation start-ups, inspections, and testing related to all systems to be commissioned under this specification.

1. Notify Testing Agency of all meetings, conferences, tests, start-ups, and inspections as specified by A/E under all sections referenced in the summary section of this specification 2 weeks prior to scheduled date of event.

B. Contractor shall copy Testing Agency on all required inspections and testing reports related to all systems to be commissioned under this specification.

1. Provide reports from all tests as specified by A/E under all sections referenced in the summary section of this specification

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Testing of Mockup and Installed Work: Provide testing scopes below on installed work at intervals indicated, as well as at the mock-up. Successful testing of mock-up must proceed installation of exterior enclosure.

B. Division 04 Section ‘Unit Masonry’ exterior enclosure testing requirements, performed continuously alongside exterior masonry erection, performed by Masonry Contractor.

1. Contractor shall verify all water sis draining to the exterior through the weeps before continuing with exterior wythe before capping wall.

a. Do not precede more than 3 veneer courses above flashing without testing, A/E and CxP observation and digital documentation by contractor required.
b. Contractor shall hold water hose and with standard water pressure force water into the cavity at a cell vent so water can be observed coming out adjacent weeps for a period of at least 5 minutes. Contractor shall continue down the wall to the next cell vent where a weep did not indicate water wicking out and continue this process until the entire length of flashing is tested.

Testing Agency at the Mockup and in the progress of the Work at a minimum of three locations at 3 completion intervals (10%, 50%, 75%), prior to the installation of exterior finishes:

c. Where water is observed inside the building or outside the building away from the weeps, masonry units shall be removed and flashing re-inspected and repaired.
d. Water test shall be re-performed where flashing was repaired.
e. Provide a testing report outlining procedures, dates, and issues corrected with photographic evidence of the testing to the A/E and CxP for review

C. Division 07 Section 07 27 26 Fluid Applied Membrane Barriers exterior enclosure testing requirements performed at a minimum of 3 locations at 3 completion intervals (10%, 50%, 75%) by the Testing Agency:

1. Adhesion Testing; ASTM D4541.
2. Air leakage testing, via Bubble Gun; ASM E1186.
3. Water Penetrating Testing; ASTM E1105.

a. Test shall be performed without applied air pressure.
b. Test duration should last 2 hours, minimum per test.
c. Wherever evidence of air leakage has occurred as a result of the test the contractor shall make the sample airtight in a manner acceptable to the Owner/ Architect. Once measures have been put into place and the appropriate curing time has passed a second test of the sample shall be conducted in the same manner as the first. Should unacceptable leakage still be found, further remedial measures shall be implemented and testing shall be repeated until the sample has been deemed acceptable by the Owner/ Architect

D. Division 07 Section 07 42 64 Metal Composite Material Wall Panels exterior enclosure testing requirements to be performed by the Testing Agency at the Mockup and in theprogress of the Work at a minimum of three locations at 3 completion interval (10%, 50%, 75%), prior to the installation of exterior of exterior finishes:

1. Penetration Testing: AAMA 501.2. Insulated metal wall panels including unique edge and transitions conditions for moisture penetration following procedures outlined in AAMA 501.2 and per testing criteria below

a. Testing shall occur after wall panels are weather tight but prior to installation of interior finishes allowing for adequate viewing of potential leakage from both the interior and exterior of the building.
b. Wherever water leakage has occurred as a result of the test the contractor shall make the sample watertight in a manner acceptable to the Owner/ Architect. Once measures have been put into place and the appropriate curing time has passed a second test of the sample shall be conducted in the same manner as the first. Should leakage still be found, further remedial measures shall be implemented and testing shall be repeated until the sample has been deemed acceptable by the Owner/ Architect.

E. Division 07 Section 07 52 16 'SBS Modified Bituminous Membrane Roofing' exterior enclosure testing requirements:

1. Electrical Field Vector Mapping (EFVM). At field of roof for leak detection on waterproofing membrane for testing of capillary defects and/or breaches in the membrane. Testing is to be administered by the Testing Agency.

a. Contractor to submit wiring diagrams prior to scheduling test.
b. Low-Voltage Electric Field Vector Mapping

1) Entire roof to be tested on an area-by-area basis.
2) Entire membrane test area to be wetted with water prior to the start of each test and maintained as wet for the duration of testing. Integrity of the membrane at drains and penetrations to be verified by localized testing.

c. High-Voltage Leak Detection Testing

1) Perimeter of entire roof and any other areas not able to be tested using low-voltage method are to be tested.

2) Waterproofing membrane to be dry prior to and during high voltage testing
3) Entire roof surface to be swept by overlapping individual swept areas by a minimum of 3”

d. If a breach is detected, the testing technician shall report to the roofing contractor immediately.
e. Defects found shall be immediately repaired by roofing contractor and retested by technician using high-voltage method
f. All costs associated with the re-work shall be borne by the contractor responsible for the initial construction.
g. Test shall occur prior to issuance of notice of substantial completion.

2. Flood Testing of Roof Drains to be performed by the Contractor with Architect, Owner and Construction Manager observation.

3. The Owner reserves the right to request the Testing Agency to perform a thermographic scan of the roof per ASTM C1153 to determine if any damp or wet materials have been installed

F. Division 07 Section ‘Joint Sealants’ exterior enclosure testing requirements, performed on a minimum of 2% of total length of sealant joints at 3 completion intervals (10%, 50%, 75%):

1. Adhesion Pull Test; ASTM C 1521. Wherever sealant failure has occurred as a result of the test the contractor shall make review and revise the installation of the sample in a manner acceptable to the Owner/ Architect. Once measures have been put into place and the appropriate curing time has passed a second test of the sample shall be conducted in the same manner as the first. Should failure still occur, further remedial measures shall be implemented and testing shall be repeated until the sample has been deemed acceptable by the Owner/ Architect.

G. Division 08 Section ‘Glazed Aluminum Curtain Walls’ exterior enclosure testing requirements, performed at a minimum of 3 locations at 3 completion intervals (10%, 50%, 75%). At Mockup and 10% test, each unique installation condition shall be tested.

1. Air Infiltration Testing; ASTM E783.
2. Water Penetration Testing; ASTM E1105
3. Water Penetration Testing, without Applied Pressure; ASTM 1105. Test duration should last 2 hours, minimum per test.
   a. Wherever water leakage has occurred as a result of the test the contractor shall make the sample watertight in a manner acceptable to the Owner/Architect. Once measures have been put into place and the appropriate curing time has passed a second test of the sample shall be conducted in the same manner as the first. Should leakage still be found, further remedial measures shall be implemented and testing shall be repeated until the sample has been deemed acceptable by the Owner/Architect.

3.2 FUNCTIONAL PERFORMANCE TESTING

A. Contractor shall be responsible for participation in all Functional Performance Testing

B. Any additional testing required because of failure of the tested sample to meet specifications shall be paid for by the Contractor including time and materials rates for Owner, A/E, and Testing Agency to witness test results

C. Thermal Imaging Functional Performance Test

1. Testing Agency will develop and conduct a Thermal Imaging Functional Performance Test of the entire building envelope system in accordance with ASTM C 1060, ASTM E 1186, and ISO 6781.
2. Test will require access to project site during off hours and manipulation of building controls to maintain prescribed ambient temperature differences.

END OF SECTION 01 90 00

SECTION 01 91 13 - COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION:

A. Commissioning – Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems.
3. Verify that O&M documentation left on site is complete.
4. Verify that the Owner's operating personnel are adequately trained.

B. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

C. Abbreviations. The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan.* Definitions are found in Section #.#.

A/E-	Architect and design engineers	FT-	Functional performance test
CxA-	Commissioning authority	GC-	General contractor (prime)
CC	Controls contractor	MC-	Mechanical contractor
TAB-	Test and balance contractor	PC-	Pre-functional checklist
Cx-	Commissioning	PM-	Project manager (of the Owner)
Cx Plan-	Commissioning Plan document	Subs-	Subcontractors to General
EC-	Electrical contractor		

1.2 COORDINATION:

A. Commissioning Team. The members of the commissioning team consist of the Commissioning authority (CxA), the Project Manager (PM), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

B. Management. The CxA is hired by the Owner. The CxA directs and coordinates the commissioning activities. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. The CxA's responsibilities are the same regardless of who hired the CxA. Refer to Section 01 91 13 Part 1.6 for additional management details.

C. Scheduling. The CxA will work with the PM and GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the PM and GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The *Commissioning Plan* provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

1.3 COMMISSIONING PROCESS:

A. Commissioning Plan. The *Commissioning Plan*, provided as part of the bid documents, is binding on the Contractor. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CxA will update the plan which is then considered the "final" plan, though it will continue to evolve and expand as the project progresses. The *Specifications* will take precedence over the *Commissioning Plan*.

B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.

2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.

3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.

4. The CxA works with the Subs in developing startup plans and startup documentation formats, including providing the Subs with pre-functional checklists to be completed, during the startup process.

5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with pre-functional checklists being completed before functional testing.

6. The Subs, under their own direction, execute and document the pre-functional checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.

7. The CxA develops specific equipment and system functional performance test procedures. The Subs review the procedures.

8. The procedures are executed by the Subs, under the direction of, and documented by the CxA.

9. Items of non-compliance in material, installation or setup are corrected at the Sub's expense and the system retested.

10. The CxA reviews the O&M documentation for completeness.

11. Commissioning not necessarily completed before Substantial Completion.

12. The CxA reviews, pre-approves, coordinates and verifies that the training was provided by the Subs.

13. Deferred testing is conducted, as specified or required.

1.4 RELATED WORK:

A. Specific commissioning requirements are given in other sections of these specifications. The contractor shall check all specification sections specifically sections 013114, 013301, 017713, 017824, 230001, 230810, 230811, 230812, 230813, 230905, 260000, 260810, 260811, 260812, 260813 for information related to commissioning.

1.5 RESPONSIBILITIES:

A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the mechanical contractor, TAB and controls contractor are in Division 23 and those of the electrical contractor in Division 26. It is noted that the services for the Project Manager, Architect, HVAC mechanical and electrical designers/engineers, and Commissioning authority are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

B. All Parties

1. Follow the Commissioning Plan.

2. Attend commissioning scoping meeting and additional meetings, as necessary.

C. Architect (of A/E)

Construction and Acceptance Phase

1. Attend the commissioning scoping meeting and selected commissioning team meetings.

2. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.

3. Provide any design narrative documentation requested by the CxA.

4. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.

5. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

Warranty Period

1. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

D. Mechanical and Electrical Designers/Engineers (of the A/E)

Construction and Acceptance Phase

1. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.

2. Designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

3. Attend commissioning scoping meetings and other selected commissioning team meetings.

4. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.

5. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

6. From the Contractor's red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for for what?

7. Provide any design narrative and sequences documentation requested by the CxA. The chilled and hot water, domestic water, steam and condensate systems; supply, return and exhaust air systems.

Warranty Period

1. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

E. Commissioning Authority (CxA)

1. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CxA.

Construction and Acceptance Phase

1. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

2. Coordinate the commissioning work and, with the GC and PM, ensure that commissioning activities are being scheduled into the master schedule.

3. Revise, as necessary *Commissioning Plan.*

4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.

5. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.

6. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.

7. Review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.

8. Write and distribute pre-functional tests and checklists.

9. Perform site visits, as necessary, to observe component and system installations. Attends selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.

10. Witness all or part of the HVAC piping test and flushing procedure, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owners' project manager of any deficiencies in results or procedures.

11. Witness all or part of any ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's project manager of any deficiencies in results or procedures.
12. Approve pre-functional tests and checklist completion by reviewing pre-functional checklist reports and by selected site observation and spot checking.

13. Approve systems startup by reviewing start-up reports and by selected site observation.

14. Review TAB execution plan.

15. Oversee sufficient functional testing of the control system.

16. Approve air and water systems balancing by spot testing, by reviewing completed reports and by selected site observation.

17. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing. Submit to PM for review, and for approval if required.

18. Analyze any functional performance trend logs and monitoring data to verify performance.

19. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.

20. Maintain a master deficiency and resolution log and a separate testing record. Provide the PM with written progress reports and test results with recommended actions.

21. Witness performance testing and all other owner contracted tests or tests by manufacturer's personnel over which the CxA may not have direct control. Document these tests and include this documentation in Commissioning Record in O&M manuals.

22. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.

23. Oversee and approve the training of the Owner's operating personnel.

24. Compile and maintain a commissioning record.

25. Review and approve the preparation of the O&M manuals.

26. Provide a final commissioning report (as described in this section).

Warranty Period

1. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.

2. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

F. Owner's Project Manager (PM)

Construction and Acceptance Phase

1. Facilitate the coordination of the commissioning work by the CxA, and, with the GC and CxA, ensure that commissioning activities are being scheduled into the master schedule.

2. Review and approve the final *Commissioning Plan.*

3. Attend a commissioning scoping meeting and other commissioning team meetings.

4. Perform the normal review of Contractor submittals.

5. Review and approve the functional performance test procedures submitted by the CxA, prior to testing.

6. When necessary, observe and witness pre-functional checklists, startup and functional testing of selected equipment.

7. Review commissioning progress and deficiency reports.

8. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.

9. Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the Project Manager.

10. Assist the GC in coordinating the training of owner personnel.

11. Manage the contract of the A/E and of the GC.

12. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the *Commissioning Plan.*

13. Provide final approval for the completion of the commissioning work.

Warranty Period

1. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

G. General Contractor (GC)

Construction and Acceptance Phase

1. Facilitate the coordination of the commissioning work by the CxA, and with the GC and CxA ensure that commissioning activities are being scheduled into the master schedule.

2. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.

3. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.

4. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.

5. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.

6. Coordinate the training of owner personnel.

7. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

8. Responsibilities for submission for systems manual information.

9. Provide all lifts and utilities to facilitate envelope testing.

10. Provide time before and pre-conditioning to facilitate IAQ testing.

Warranty Period

1. Ensure that Subs execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

2. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

H. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.

2. Assist in equipment testing per agreements with Subs.

3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone datalogging equipment that may be used by the CxA.

4. Through the contractors they supply products to, analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.

5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

6. Review test procedures for equipment installed by factory representatives.

1.6 DEFINITIONS

A. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

B. Approval - acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.

C. Architect / Engineer (A/E) - the prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.

D. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the design intent may be included.

E. Commissioning authority (CxA) - an independent agent, not otherwise associated with the A/E team members or the Contractor, though he/she may be hired as a subcontractor to them. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the PM. The CxA shall report directly to the PM.

F. Commissioning Plan - an overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process.

G. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, *Cx Plan*, etc.).

H. Contractor - the general contractor or authorized representative.

I. Control system - the central building energy management control system.

J. Datalogging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.

K. Deferred Functional Tests - FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.

L. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).

M. Design Intent - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.

N. Design Narrative or Design Documentation - sections of either the Design Intent or Basis of Design.

O. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.

P. Functional Performance Test (FT) - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after pre-functional checklists and startup are complete.

Q. General Contractor (GC) - the prime contractor for this project. Generally refers to all the GC's subcontractors as well. Also referred to as the Contractor, in some contexts.

R. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

S. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

T. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.

U. Non-Compliance - see Deficiency.

V. Non-Conformance - see Deficiency.

W. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."

X. Owner-Contracted Tests - tests paid for by the Owner outside the GC's contract and for which the CxA does not oversee. These tests will not be repeated during functional tests if properly documented.

Y. Phased Commissioning - commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.

Z. Pre-functional Checklist (PC) - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Sub. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word pre-functional refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the pre-functional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the pre-functional checklisting, except for larger or more critical pieces of equipment.

AA. Project Manager (PM) - the contracting and managing authority for the owner over the design and/or construction of the project, a staff position.

BB. Sampling. - functionally testing only a fraction of the total number of identical or near identical pieces of equipment. Refer to Section 01 91 13, Part 3.6, J for details.

CC. Seasonal Performance Tests - FT that are deferred until the system(s) will experience conditions closer to their design conditions.

DD. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

EE. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

FF. Specifications - the construction specifications of the Contract Documents.

GG. Startup - the initial starting or activating of dynamic equipment, including executing pre-functional checklists.

HH. Subs - the subcontractors to the GC who provide and install building components and systems.

II. Test Procedures - the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.

JJ. Test Requirements - requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents (Sections 23 08 11; 26 08 11, etc.).

KK. Trending - monitoring using the building control system.

LL. Vendor - supplier of equipment.

MM. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.7 SYSTEMS TO BE COMMISSIONED

A. The following checked systems will be commissioned in this project.

Equipment and System	Functional Test Requirements Specified In:	Equipment and System	Functional Test Requirements Specified In:
HVAC System		x Equipment vibration control	23 08 11
x Chillers	23 08 11	__ Egress pressurization	23 08 11
x Pumps	23 08 11	**Electrical System**	
x Cooling tower	23 08 11	x Sweep or scheduled lighting controls	26 08 11
x Heat Transfer Package	23 08 11	__ Daylight dimming controls	26 08 11
x Piping systems	23 08 11	x Lighting occupancy sensors	26 08 11
x Ductwork	23 08 11	x Power quality	26 08 11
__ Variable frequency drives	23 08 11	__ Security system	26 08 11
x Air handler units	23 08 11	x Emergency power system	26 08 11
__ VRF System	23 08 11	x UPS systems	26 08 11
x Pool Dehumidification Air Handling Units	23 08 11		
__ Fan coil units	23 08 11	x Fire and smoke alarm	26 08 11
__ Unit heaters	23 08 11	x Fire protection systems	26 08 11
__ Fan powered boxes	23 08 11	__ Communications system	26 08 11
__ VAV boxes	23 08 11	__ Public address/paging	26 08 11
__ Kitchen make-up air unit	23 08 11		
__ Kitchen exhaust fans	23 08 11	**Other**	
x Exhaust fans	23 08 11	x Domestic hot water heaters	23 08 11
x Testing, Adjusting and Balancing work	23 08 11	__ Service water booster pumps	23 08 11
__ Chemical treatment systems	23 08 11	__ Building Envelope	
x HVAC control system	23 08 11	__ Medical gas systems	23 08 01
x Fire and smoke dampers	23 08 11	x Sump Pump	23 08 11
x Indoor air quality[1]	23 08 11		
__ Condensate return unit	23 08 11		

[1] Indoor air quality (IAQ) commissioning does not ensure that indoor air quality will be adequate or without deficiency at building turnover or during occupancy, unless the owner has specifically specified that actual air quality testing is performed. Commissioning indoor air quality entails performing tasks that minimize the potential for IAQ problems, but it does not eliminate their possibility.

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division # shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division #, except for equipment specific to and used by TAB in their commissioning responsibilities.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CxA.

C. Datalogging equipment and software required to test equipment will be provided by the CxA but shall not become the property of the Owner.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications.* If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

E. Refer to Section 01 91 13, Part 3.6 E for details regarding equipment that may be required to simulate required test conditions.

PART 3 – EXECUTION

3.1 MEETINGS

A. Scoping Meeting. Within 90 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Draft *Commissioning Plan* to its "final" version, which will also be distributed to all parties.

B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs. For large projects, these meetings may be held monthly.

3.2 REPORTING

A. The CxA will provide regular reports to the PM, depending on the management structure, with increasing frequency as construction and commissioning progresses. Standard forms are provided and referenced in the *Commissioning Plan.*

B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

D. A final summary report (about four to eight pages, not including backup documentation) by the CxA will be provided to the PM, focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. Pre-functional checklists, functional tests and monitoring reports will not be part of the final report but will be stored in the Commissioning Record in the O&M manuals.

3.3 SUBMITTALS

A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning authority. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.

B. The Commissioning authority will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning authority will notify the CM, PM or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which requires resubmission.

C. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review and approve them.

3.4 START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned, according to Section 1.7, Systems to be commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PCs and startup.

B. General. Pre-functional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full pre-functional checkout. No sampling strategies are used. The pre-functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for pre-functional checklists and

startup are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing requirements in Sections 23 08 11 and 26 08 11.

1. The CxA adapts, if necessary, the representative pre-functional checklists and procedures from Section 23 08 12 and 26 08 12. These checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.

2. These checklists and tests are provided by the CxA to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form will have more than one trade responsible for its execution.

3. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

4. The full start-up plan could consist of something as simple as:

   a. The CxA's pre-functional checklists.

   b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.

   c. The manufacturer's normally used field checkout sheets.

5. The subcontractor submits the full startup plan to the CxA for review and approval.

6. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.

7. The full start-up procedures and the approval form may be provided to the CM for review and approval, depending on management protocol.

D. Sensor and Actuator Calibration.

1. All field-installed temperature, relative humidity, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner before-hand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* the unit at the factory with calibration certification provided need not be field calibrated.

2. All procedures used shall be fully documented on the pre-functional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

E. Sensor Calibration Methods

1. All Sensors. Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.

2. Sensors Without Transmitters--Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.

3. Sensors with Transmitters--Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

4. Critical Applications. For critical applications (process, manufacturing, etc.) more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

Tolerances, Standard Applications

Sensor	Required Tolerance (+/-)	Sensor	Required Tolerance (+/-)
Cooling coil, chilled and condenser water temps	0.4F	Flow rates, water	4% of design
		Relative humidity	4% of design
AHU wet bulb or dew point	2.0F	Combustion flue temps	5.0F
Hot water coil and boiler water temp	1.5F	Oxygen or CO_2 monitor	0.1 % pts
Outside air, space air, duct air temps	0.4F	CO monitor	0.01 % pts
Watthour, voltage & amperage	1% of design	Natural gas and oil flow rate	1% of design
Pressures, air, water and gas	3% of design	Steam flow rate	3% of design
Flow rates, air	10% of design	Barometric pressure	0.1 in. of Hg

F. Valve and Damper Stroke Setup and Check

1. EMS Readout. For all valve and damper actuator positions checked, verify the actual position against the BAS readout.

2. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3. Closure for heating coil valves (NO): Set heating setpoint 20°F above room temperature. Observe valve open. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set heating setpoint to 20°F below room temperature. Observe the valve close. For pneumatics, by override in the EMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.

4. Closure for cooling coil valves (NC): Set cooling setpoint 20°F above room temperature. Observe the valve close. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set cooling setpoint to 20°F below room temperature. Observe valve open. For pneumatics, by override in the EMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.

G. Execution of Pre-functional Checklists and Startup.

1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the GC and CxA. The performance of the pre-functional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off pre-functional checklists, signatures may be required of other Subs for verification of completion of their work.

2. The CxA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the PM). In no case will the number of units witnessed be less than four on anyone building, nor less than 20% of the total number of identical or very similar units.

3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the pre-functional and start-up procedures. The sampling procedures are identified in the commissioning plan.

4. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and pre-functional tests and checklists.

5. Only individuals that have direct knowledge and witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

H. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Subs shall clearly list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.

2. The CxA reviews the report and submits either a non-compliance report or an approval form to the Sub or PM. The CxA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the execution of the checklists and startup of each system to the PM using a standard form.

3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party. Refer to Part 3.7 herein for details.

4. Failure of any owner provided testing to include at a minimum IAQ and envelope testing will require the offending party to pay for retesting in full including all expenses, rental of testing equipment, labor etc.

3.5 PHASED COMMISSIONING

A. The project will *not* require startup and initial checkout to be executed in phases.

3.6 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to all commissioning functional testing for all divisions.

B. The general list of equipment to be commissioned is found in Section 01 91 13, Part 1.7. The specific equipment and modes to be tested are found in Sections 23 08 11 and 26 08 11.

C. The parties responsible to execute each test are listed with each test in Sections 23 08 11 and 26 08 11.

D. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

E. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested. Specific modes required in this project are given in Sections 23 08 11 and 26 08 11.

F. Development of Test Procedures. Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements in Sections 23 08 11 and 26 08 11 the CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test, shall provide limited assistance to the CxA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA may submit the tests to the A/E for review, if requested.

G. The CxA shall review owner-contracted, factory testing or required owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the *Specifications*. Redundancy of testing shall be minimized.

H. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

I. Representative test formats and examples (not designed for this facility) are found in the appendices to Divisions 23 and 26. The test procedure forms developed by the CxA shall include (but not be limited to) the following information:

1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique pre-functional checklist and start-up documentation ID numbers for the piece of equipment
4. Date
5. Project name
6. Participating parties

7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pre-test field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
15. A section for comments
16. Signatures and date block for the CxA

J. Test Methods.

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. Sections 23 08 11 and 26 08 11 specify which methods shall be used for each test. The CxA may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the PM. This may require a change order and adjustment in charge to the Owner. The CxA will determine which method is most appropriate for tests that do not have a method specified.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended overusing the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the

indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during pre-functional testing.

7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

8. Sampling. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. The specific recommended sampling rates are specified with each type of equipment in Sections 23 08 11 and 26 08 11. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.

    a. A common sampling strategy referenced in the *Specifications* as the "xx% Sampling—yy% Failure Rule" is defined by the following example.

        1) xx = the percent of the group of identical equipment to be included in each sample.

        2) yy = the percent of the sample that if failing, will require another sample to be tested.

    b. The example below describes a 20% Sampling—10% Failure Rule.

        1) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."

        2) If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).

        3) If 10% of the units in the second sample fail, test all remaining units in the whole group.

        4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

K. Coordination and Scheduling. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the pre-functional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the GC and affected Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

L. In general, functional testing is conducted after pre-functional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

M. Test Equipment. Refer to Section 01 91 13, Part 2 for test equipment requirements.

N. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

3.7 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation. The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the PM for review and approval and to the Subs for review. The CxA will include the filled out forms in the O&M manuals.

B. Non-Conformance.

1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the PM on a standard non-compliance form.

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.

3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the PM.

4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.

   a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:

      1) The CxA documents the deficiency and the Sub's response and intentions, and they go on to another test or sequence. After the day's work, the CxA submits the non-compliance reports to the PM for signature, if required. A copy is provided to the Sub and CxA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.

      2) The CxA reschedules the test, and the test is repeated.

   b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

      1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the Sub representative assumed to be responsible.

      2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.

      3) The CxA documents the resolution process.

      4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test, and the test is repeated until satisfactory performance is achieved.

5. Cost of Retesting.

   a. The cost for the *Sub* to retest a pre-functional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.

b. For a deficiency identified, not related to any pre-functional checklist or start-up fault, the following shall apply: The CxA will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CxA's time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.

c. The time for the CxA to direct any retesting required because a specific *pre-functional* checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the party responsible for executing the faulty pre-functional test.

d. Refer to the sampling section of Section 01 91 13, Part 3.6 for requirements for testing and retesting identical equipment.

6. The Contractor shall respond in writing to the CxA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.

7. The CxA retains the original non-conformance forms until the end of the project.

8. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.

C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the PM. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the PM, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the PM within two weeks of the original notice.

2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The PM will determine whether a replacement of all identical units or a repair is acceptable.

4. Two examples of the proposed solution will be installed by the Contractor and the GC will be allowed to test the installations for up to one week, upon which the PM will decide whether to accept the solution.

5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the PM, if necessary. The CxA recommends acceptance of each test to the PM using a standard form. The PM gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.8 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals.

1. The specific content and format requirements for the standard O&M manuals are detailed in Section 01 78 23. Special requirements for the controls contractor and TAB contractor are found Section 23 08 10, Part 3.8.

2. A/E Contribution. The A/E will include in the beginning of the O&M manuals a separate section describing the systems including:

   a. The design intent narrative prepared by the A/E and provided as part of the bid documents, updated to as-built status by the A/E.

3. CxA Review and Approval. Prior to substantial completion, the CxA shall review the O&M manuals, documentation and redline as-builds *for systems that were commissioned* to verify compliance with the *Specifications.* The CxA will communicate deficiencies in the manuals to the PM or A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the PM or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Commissioning Record in O&M Manuals.

1. The CxA is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the GC, to be included with the O&M manuals. Three copies of the manuals will be provided. The format of the manuals shall be:

   a. *Tab I-1* Commissioning Plan

   b. *Tab I-2* Final Commissioning Report (see (B.2) below)

   c. *Tab 01* System Type 1 (chiller system, packaged unit, boiler system, etc.)

   d. *Sub-Tab A* Design narrative and criteria, sequences, approvals for Equipment 1

   e. *Sub-Tab B* Startup plan and report, approvals, corrections, blank pre-functional checklists

   f. *Colored Separator Sheets*—for each equipment type (fans, pumps, chiller, etc.)

   g. *Sub-Tab C* Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.

   h. *Tab 02* System Type 2.....repeat as per System 1

2. Final Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece

of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

3. Current Facilities Requirements and Operations and Maintenance Plan - Systems Manual
Prepare and maintain a current facilities requirements and operations and maintenance plan that contains the information necessary to operate the building efficiently. The plan must include the following:
    - A sequence of operations for the building
    - The building occupancy schedule
    - Equipment run-time schedules
    - Setpoints for all HVAC equipment
    - Set lighting levels throughout the building
    - Minimum outside air requirements
    - Any changes in schedules or setpoints for different seasons, days of the week, and times of day
    - A systems narrative describing the mechanical and electrical systems and equipment
    - A preventive maintenance plan for building equipment described in the systems narrative
    - A commissioning program that includes periodic commissioning requirements, ongoing commissioning tasks, and continuous tasks for critical facilities.

4. Other documentation will be retained by the CxA.

3.9 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

1. The CxA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the Subs and vendors who have training responsibilities.

2. In addition to these general requirements, the specific training requirements of Owner personnel by Subs and vendors is specified in Division 23 and 26.

3. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. The plan will cover the following elements:

    a. Equipment (included in training)

    b. Intended audience

    c. Location of training

    d. Objectives

    e. Subjects covered (description, duration of discussion, special methods, etc.)

    f. Duration of training on each subject

    g. Instructor for each subject

h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)

i. Instructor and qualifications

4. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

5. The CxA develops an overall training plan and coordinates and schedules, with the PM and GC, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the PM using a standard form. The PM also signs the approval form.

6. At one of the training sessions, the CxA presents a __1__ hour presentation discussing the use of the blank functional test forms for re-commissioning equipment.

7. Video taping of the training sessions will be provided by the GC with tapes cataloged by the GC and added to the O&M manuals.

8. The mechanical design engineer shall at the first training session present the overall system design concept and the design concept of each equipment section. This presentation shall be __2___ hours in length and include a review of all systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water or heat rejection systems, heating systems, fuel oil and gas supply systems, supply air systems, exhaust system and outside air strategies.

3.10 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) specified in Section 23 08 11 shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.

3.11 WRITTEN WORK PRODUCTS

A. The commissioning process generates a number of written work products described in various parts of the *Specifications.* The *Commissioning Plan,* lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

Product	Developed By
1. Final commissioning plan	CxA
2. Cx meeting minutes	CxA
3. Commissioning schedules	CxA with GC and CM
4. Equipment documentation submittals	Subs

5.	Sequence clarifications		Subs and A/E as needed
6.	Pre-functional checklists		CxA
7.	Startup and initial checkout plan		Subs and CxA (compilation of existing documents)
8.	Startup and initial checkout forms filled out	Subs	
9.	Final TAB report		TAB
10.	Issues log (deficiencies)		CxA
11.	Commissioning Progress Record		CxA
12.	Functional test forms		CxA
13.	Systems Manual		CxA
14.	Filled out functional tests		CxA
15.	O&M manuals	Subs	
16.	Overall training plan		CxA and CM
17.	Specific training agendas		Subs
18.	Final commissioning report	CxA	
19.	Misc. approvals		CxA

3.12 IAQ TESTING

A. The general contractor will assist the commissioning agent in scheduling the IAQ testing. Prior to the testing all finishes shall be complete for at least 72 hours, the building will be purged with as much conditioned outside air as possible and the building will be unoccupied.

B. The building will remain unoccupied during the testing (approximately 8 hours) and the HVAC systems will be run normally as if the building was occupied.

C. The cost of retesting will be born by the offending party if the IAQ test is unsuccessful.

END OF SECTION

SECTION 01 91 13 - COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION:

A. Commissioning – Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems.
3. Verify that O&M documentation left on site is complete.
4. Verify that the Owner's operating personnel are adequately trained.

B. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

C. Abbreviations. The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan.* Definitions are found in Section #.#.

A/E-	Architect and design engineers	FT-	Functional performance test
CxA-	Commissioning authority	GC-	General contractor (prime)
CC	Controls contractor	MC-	Mechanical contractor
TAB-	Test and balance contractor	PC-	Pre-functional checklist
Cx-	Commissioning	PM-	Project manager (of the Owner)
Cx Plan-	Commissioning Plan document	Subs-	Subcontractors to General
EC-	Electrical contractor		

1.2 COORDINATION:

A. Commissioning Team. The members of the commissioning team consist of the Commissioning authority (CxA), the Project Manager (PM), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

B. Management. The CxA is hired by the Owner. The CxA directs and coordinates the commissioning activities. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. The CxA's responsibilities are the same regardless of who hired the CxA. Refer to Section 01 91 13 Part 1.6 for additional management details.

C. Scheduling. The CxA will work with the PM and GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the PM and GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The *Commissioning Plan* provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

1.3 COMMISSIONING PROCESS:

A. Commissioning Plan. The *Commissioning Plan*, provided as part of the bid documents, is binding on the Contractor. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CxA will update the plan which is then considered the "final" plan, though it will continue to evolve and expand as the project progresses. The *Specifications* will take precedence over the *Commissioning Plan*.

B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.

2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.

3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.

4. The CxA works with the Subs in developing startup plans and startup documentation formats, including providing the Subs with pre-functional checklists to be completed, during the startup process.

5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with pre-functional checklists being completed before functional testing.

6. The Subs, under their own direction, execute and document the pre-functional checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.

7. The CxA develops specific equipment and system functional performance test procedures. The Subs review the procedures.

8. The procedures are executed by the Subs, under the direction of, and documented by the CxA.

9. Items of non-compliance in material, installation or setup are corrected at the Sub's expense and the system retested.

10. The CxA reviews the O&M documentation for completeness.

11. Commissioning not necessarily completed before Substantial Completion.

12. The CxA reviews, pre-approves, coordinates and verifies that the training was provided by the Subs.

13. Deferred testing is conducted, as specified or required.

1.4 RELATED WORK:

A. Specific commissioning requirements are given in other sections of these specifications. The contractor shall check all specification sections for information related to commissioning.

1.5 RESPONSIBILITIES:

A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the mechanical contractor, TAB and controls contractor are in Division # and those of the electrical contractor in Division #. It is noted that the services for the Project Manager, Architect, HVAC mechanical and electrical designers/engineers, and Commissioning authority are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

B. All Parties

1. Follow the Commissioning Plan.

2. Attend commissioning scoping meeting and additional meetings, as necessary.

C. Architect (of A/E)

Construction and Acceptance Phase

1. Attend the commissioning scoping meeting and selected commissioning team meetings.

2. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.

3. Provide any design narrative documentation requested by the CxA.

4. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.

5. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

Warranty Period

1. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

D. Mechanical and Electrical Designers/Engineers (of the A/E)

Construction and Acceptance Phase

1. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.

2. Designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

3. Attend commissioning scoping meetings and other selected commissioning team meetings.

4. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.

5. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

6. From the Contractor's red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for for what?

7. Provide any design narrative and sequences documentation requested by the CxA. The chilled and hot water, domestic water, steam and condensate systems; supply, return and exhaust air systems.

Warranty Period

1. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

E. Commissioning Authority (CxA)

1. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CxA.

Construction and Acceptance Phase

1. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

2. Coordinate the commissioning work and, with the GC and PM, ensure that commissioning activities are being scheduled into the master schedule.

3. Revise, as necessary *Commissioning Plan.*

4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.

5. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.

6. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.

7. Review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.

8. Write and distribute pre-functional tests and checklists.

9. Perform site visits, as necessary, to observe component and system installations. Attends selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.

10. Witness all or part of the HVAC piping test and flushing procedure, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owners' project manager of any deficiencies in results or procedures.

11. Witness all or part of any ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's project manager of any deficiencies in results or procedures.
12. Approve pre-functional tests and checklist completion by reviewing pre-functional checklist reports and by selected site observation and spot checking.

13. Approve systems startup by reviewing start-up reports and by selected site observation.

14. Review TAB execution plan.

15. Oversee sufficient functional testing of the control system.

16. Approve air and water systems balancing by spot testing, by reviewing completed reports and by selected site observation.

17. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing. Submit to PM for review, and for approval if required.

18. Analyze any functional performance trend logs and monitoring data to verify performance.

19. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.

20. Maintain a master deficiency and resolution log and a separate testing record. Provide the PM with written progress reports and test results with recommended actions.

21. Witness performance testing and all other owner contracted tests or tests by manufacturer's personnel over which the CxA may not have direct control. Document these tests and include this documentation in Commissioning Record in O&M manuals.

22. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.

23. Oversee and approve the training of the Owner's operating personnel.

24. Compile and maintain a commissioning record.

25. Review and approve the preparation of the O&M manuals.

26. Provide a final commissioning report (as described in this section).

Warranty Period

1. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.

2. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

F. Owner's Project Manager (PM)

Construction and Acceptance Phase

1. Facilitate the coordination of the commissioning work by the CxA, and, with the GC and CxA, ensure that commissioning activities are being scheduled into the master schedule.

2. Review and approve the final *Commissioning Plan.*

3. Attend a commissioning scoping meeting and other commissioning team meetings.

4. Perform the normal review of Contractor submittals.

5. Review and approve the functional performance test procedures submitted by the CxA, prior to testing.

6. When necessary, observe and witness pre-functional checklists, startup and functional testing of selected equipment.

7. Review commissioning progress and deficiency reports.

8. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.

9. Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the Project Manager.

10. Assist the GC in coordinating the training of owner personnel.

11. Manage the contract of the A/E and of the GC.

12. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the *Commissioning Plan.*

13. Provide final approval for the completion of the commissioning work.

Warranty Period

1. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

G. General Contractor (GC)

Construction and Acceptance Phase

1. Facilitate the coordination of the commissioning work by the CxA, and with the GC and CxA ensure that commissioning activities are being scheduled into the master schedule.

2. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.

3. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.

4. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.

5. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.

6. Coordinate the training of owner personnel.

7. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

8. Responsibilities for submission for systems manual information.

9. Provide all lifts and utilities to facilitate envelope testing.

10. Provide time before and pre-conditioning to facilitate IAQ testing.

Warranty Period

1. Ensure that Subs execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

2. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

H. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.

2. Assist in equipment testing per agreements with Subs.

3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone datalogging equipment that may be used by the CxA.

4. Through the contractors they supply products to, analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.

5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

6. Review test procedures for equipment installed by factory representatives.

1.6 DEFINITIONS

A. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

B. Approval - acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.

C. Architect / Engineer (A/E) - the prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.

D. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the design intent may be included.

E. Commissioning authority (CxA) - an independent agent, not otherwise associated with the A/E team members or the Contractor, though he/she may be hired as a subcontractor to them. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the PM. The CxA shall report directly to the PM.

F. Commissioning Plan - an overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process.

G. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, *Cx Plan*, etc.).

H. Contractor - the general contractor or authorized representative.

I. Control system - the central building energy management control system.

J. Datalogging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.

K. Deferred Functional Tests - FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.

L. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).

M. Design Intent - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.

N. Design Narrative or Design Documentation - sections of either the Design Intent or Basis of Design.

O. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.

P. Functional Performance Test (FT) - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after pre-functional checklists and startup are complete.

Q. General Contractor (GC) - the prime contractor for this project. Generally refers to all the GC's subcontractors as well. Also referred to as the Contractor, in some contexts.

R. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

S. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

T. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.

U. Non-Compliance - see Deficiency.

V. Non-Conformance - see Deficiency.

W. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."

X. Owner-Contracted Tests - tests paid for by the Owner outside the GC's contract and for which the CxA does not oversee. These tests will not be repeated during functional tests if properly documented.

Y. Phased Commissioning - commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.

Z. Pre-functional Checklist (PC) - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Sub. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word pre-functional refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the pre-functional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the pre-functional checklisting, except for larger or more critical pieces of equipment.

AA. Project Manager (PM) - the contracting and managing authority for the owner over the design and/or construction of the project, a staff position.

BB. Sampling. - functionally testing only a fraction of the total number of identical or near identical pieces of equipment. Refer to Section 01 91 13, Part 3.6, J for details.

CC. Seasonal Performance Tests - FT that are deferred until the system(s) will experience conditions closer to their design conditions.

DD. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

EE. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

FF. Specifications - the construction specifications of the Contract Documents.

GG. Startup - the initial starting or activating of dynamic equipment, including executing pre-functional checklists.

HH. Subs - the subcontractors to the GC who provide and install building components and systems.

II. Test Procedures - the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.

JJ. Test Requirements - requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents (Sections 23 08 11; 26 08 11, etc.).

KK. Trending - monitoring using the building control system.

LL. Vendor - supplier of equipment.

MM. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.7 SYSTEMS TO BE COMMISSIONED

A. The following checked systems will be commissioned in this project.

Equipment and System	Functional Test Requirements Specified In:	Equipment and System	Functional Test Requirements Specified In:
HVAC System		x Equipment vibration control	23 08 11
x Chillers	23 08 11	__ Egress pressurization	23 08 11
x Pumps	23 08 11	**Electrical System**	
x Cooling tower	23 08 11	x Sweep or scheduled lighting controls	26 08 11
x Heat Transfer Package	23 08 11	__ Daylight dimming controls	26 08 11
x Piping systems	23 08 11	x Lighting occupancy sensors	26 08 11
x Ductwork	23 08 11	x Power quality	26 08 11
__ Variable frequency drives	23 08 11	__ Security system	26 08 11
x Air handler units	23 08 11	x Emergency power system	26 08 11
__ VRF System	23 08 11	x UPS systems	26 08 11
x Pool Dehumidification Air Handling Units	23 08 11		
__ Fan coil units	23 08 11	x Fire and smoke alarm	26 08 11
__ Unit heaters	23 08 11	x Fire protection systems	26 08 11
__ Fan powered boxes	23 08 11	__ Communications system	26 08 11
__ VAV boxes	23 08 11	__ Public address/paging	26 08 11
__ Kitchen make-up air unit	23 08 11		
__ Kitchen exhaust fans	23 08 11	**Other**	
x Exhaust fans	23 08 11	x Domestic hot water heaters	23 08 11
x Testing, Adjusting and Balancing work	23 08 11	__ Service water booster pumps	23 08 11
__ Chemical treatment systems	23 08 11	__ Building Envelope	
x HVAC control system	23 08 11	__ Medical gas systems	23 08 01
x Fire and smoke dampers	23 08 11	x Sump Pump	23 08 11
x Indoor air quality[1]	23 08 11		
__ Condensate return unit	23 08 11		

[1] Indoor air quality (IAQ) commissioning does not ensure that indoor air quality will be adequate or without deficiency at building turnover or during occupancy, unless the owner has specifically specified that actual air quality testing is performed. Commissioning indoor air quality entails performing tasks that minimize the potential for IAQ problems, but it does not eliminate their possibility.

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division # shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division #, except for equipment specific to and used by TAB in their commissioning responsibilities.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CxA.

C. Datalogging equipment and software required to test equipment will be provided by the CxA but shall not become the property of the Owner.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications.* If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

E. Refer to Section 01 91 13, Part 3.6 E for details regarding equipment that may be required to simulate required test conditions.

PART 3 – EXECUTION

3.1 MEETINGS

A. Scoping Meeting. Within 90 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Draft *Commissioning Plan* to its "final" version, which will also be distributed to all parties.

B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs. For large projects, these meetings may be held monthly.

3.2 REPORTING

A. The CxA will provide regular reports to the PM, depending on the management structure, with increasing frequency as construction and commissioning progresses. Standard forms are provided and referenced in the *Commissioning Plan*.

B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

D. A final summary report (about four to eight pages, not including backup documentation) by the CxA will be provided to the PM, focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. Pre-functional checklists, functional tests and monitoring reports will not be part of the final report but will be stored in the Commissioning Record in the O&M manuals.

3.3 SUBMITTALS

A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning authority. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.

B. The Commissioning authority will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning authority will notify the CM, PM or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which requires resubmission.

C. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review and approve them.

3.4 START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned, according to Section 1.7, Systems to be commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PCs and startup.

B. General. Pre-functional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full pre-functional checkout. No sampling strategies are used. The pre-functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for pre-functional checklists and

startup are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing requirements in Sections 23 08 11 and 26 08 11.

1. The CxA adapts, if necessary, the representative pre-functional checklists and procedures from Section 23 08 12 and 26 08 12. These checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.

2. These checklists and tests are provided by the CxA to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form will have more than one trade responsible for its execution.

3. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

4. The full start-up plan could consist of something as simple as:

    a. The CxA's pre-functional checklists.

    b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.

    c. The manufacturer's normally used field checkout sheets.

5. The subcontractor submits the full startup plan to the CxA for review and approval.

6. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.

7. The full start-up procedures and the approval form may be provided to the CM for review and approval, depending on management protocol.

D. Sensor and Actuator Calibration.

1. All field-installed temperature, relative humidity, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner before-hand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* the unit at the factory with calibration certification provided need not be field calibrated.

2. All procedures used shall be fully documented on the pre-functional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

E. Sensor Calibration Methods

1. All Sensors. Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.

2. Sensors Without Transmitters--Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.

3. Sensors with Transmitters--Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

4. Critical Applications. For critical applications (process, manufacturing, etc.) more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

Tolerances, Standard Applications

Sensor	Required Tolerance (+/-)	Sensor	Required Tolerance (+/-)
Cooling coil, chilled and condenser water temps	0.4F	Flow rates, water	4% of design
		Relative humidity	4% of design
AHU wet bulb or dew point	2.0F	Combustion flue temps	5.0F
Hot water coil and boiler water temp	1.5F	Oxygen or CO_2 monitor	0.1 % pts
Outside air, space air, duct air temps	0.4F	CO monitor	0.01 % pts
Watthour, voltage & amperage	1% of design	Natural gas and oil flow rate	1% of design
Pressures, air, water and gas	3% of design	Steam flow rate	3% of design
Flow rates, air	10% of design	Barometric pressure	0.1 in. of Hg

F. Valve and Damper Stroke Setup and Check

1. EMS Readout. For all valve and damper actuator positions checked, verify the actual position against the BAS readout.

2. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3. Closure for heating coil valves (NO): Set heating setpoint 20°F above room temperature. Observe valve open. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set heating setpoint to 20°F below room temperature. Observe the valve close. For pneumatics, by override in the EMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.

4. Closure for cooling coil valves (NC): Set cooling setpoint 20°F above room temperature. Observe the valve close. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set cooling setpoint to 20°F below room temperature. Observe valve open. For pneumatics, by override in the EMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.

G. Execution of Pre-functional Checklists and Startup.

1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the GC and CxA. The performance of the pre-functional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off pre-functional checklists, signatures may be required of other Subs for verification of completion of their work.

2. The CxA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the PM). In no case will the number of units witnessed be less than four on anyone building, nor less than 20% of the total number of identical or very similar units.

3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the pre-functional and start-up procedures. The sampling procedures are identified in the commissioning plan.

4. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and pre-functional tests and checklists.

5. Only individuals that have direct knowledge and witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

H. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Subs shall clearly list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.

2. The CxA reviews the report and submits either a non-compliance report or an approval form to the Sub or PM. The CxA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the execution of the checklists and startup of each system to the PM using a standard form.

3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party. Refer to Part 3.7 herein for details.

4. Failure of any owner provided testing to include at a minimum IAQ and envelope testing will require the offending party to pay for retesting in full including all expenses, rental of testing equipment, labor etc.

3.5 PHASED COMMISSIONING

A. The project will *not* require startup and initial checkout to be executed in phases.

3.6 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to all commissioning functional testing for all divisions.

B. The general list of equipment to be commissioned is found in Section 01 91 13, Part 1.7. The specific equipment and modes to be tested are found in Sections 23 08 11 and 26 08 11.

C. The parties responsible to execute each test are listed with each test in Sections 23 08 11 and 26 08 11.

D. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

E. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested. Specific modes required in this project are given in Sections 23 08 11 and 26 08 11.

F. Development of Test Procedures. Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements in Sections 23 08 11 and 26 08 11 the CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test, shall provide limited assistance to the CxA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA may submit the tests to the A/E for review, if requested.

G. The CxA shall review owner-contracted, factory testing or required owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the *Specifications*. Redundancy of testing shall be minimized.

H. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

I. Representative test formats and examples (not designed for this facility) are found in the appendices to Divisions 23 and 26. The test procedure forms developed by the CxA shall include (but not be limited to) the following information:

1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique pre-functional checklist and start-up documentation ID numbers for the piece of equipment
4. Date
5. Project name
6. Participating parties

7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pre-test field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
15. A section for comments
16. Signatures and date block for the CxA

J. Test Methods.

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. Sections 23 08 11 and 26 08 11 specify which methods shall be used for each test. The CxA may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the PM. This may require a change order and adjustment in charge to the Owner. The CxA will determine which method is most appropriate for tests that do not have a method specified.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended overusing the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the

indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during pre-functional testing.

7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

8. Sampling. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. The specific recommended sampling rates are specified with each type of equipment in Sections 23 08 11 and 26 08 11. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.

    a. A common sampling strategy referenced in the *Specifications* as the "xx% Sampling—yy% Failure Rule" is defined by the following example.

        1) xx = the percent of the group of identical equipment to be included in each sample.

        2) yy = the percent of the sample that if failing, will require another sample to be tested.

    b. The example below describes a 20% Sampling—10% Failure Rule.

        1) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."

        2) If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).

        3) If 10% of the units in the second sample fail, test all remaining units in the whole group.

        4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

K. Coordination and Scheduling. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the pre-functional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the GC and affected Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

L. In general, functional testing is conducted after pre-functional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

M. Test Equipment. Refer to Section 01 91 13, Part 2 for test equipment requirements.

N. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

3.7 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation. The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the PM for review and approval and to the Subs for review. The CxA will include the filled out forms in the O&M manuals.

B. Non-Conformance.

1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the PM on a standard non-compliance form.

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.

3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the PM.

4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.

   a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:

      1) The CxA documents the deficiency and the Sub's response and intentions, and they go on to another test or sequence. After the day's work, the CxA submits the non-compliance reports to the PM for signature, if required. A copy is provided to the Sub and CxA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.

      2) The CxA reschedules the test, and the test is repeated.

   b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

      1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the Sub representative assumed to be responsible.

      2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.

      3) The CxA documents the resolution process.

      4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test, and the test is repeated until satisfactory performance is achieved.

5. Cost of Retesting.

   a. The cost for the *Sub* to retest a pre-functional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.

b. For a deficiency identified, not related to any pre-functional checklist or start-up fault, the following shall apply: The CxA will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CxA's time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.

c. The time for the CxA to direct any retesting required because a specific *pre-functional* checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the party responsible for executing the faulty pre-functional test.

d. Refer to the sampling section of Section 01 91 13, Part 3.6 for requirements for testing and retesting identical equipment.

6. The Contractor shall respond in writing to the CxA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.

7. The CxA retains the original non-conformance forms until the end of the project.

8. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.

C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the PM. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the PM, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the PM within two weeks of the original notice.

2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The PM will determine whether a replacement of all identical units or a repair is acceptable.

4. Two examples of the proposed solution will be installed by the Contractor and the GC will be allowed to test the installations for up to one week, upon which the PM will decide whether to accept the solution.

5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the PM, if necessary. The CxA recommends acceptance of each test to the PM using a standard form. The PM gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.8 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals.

1. The specific content and format requirements for the standard O&M manuals are detailed in Section 01 78 23. Special requirements for the controls contractor and TAB contractor are found Section 23 08 10, Part 3.8.

2. A/E Contribution. The A/E will include in the beginning of the O&M manuals a separate section describing the systems including:

   a. The design intent narrative prepared by the A/E and provided as part of the bid documents, updated to as-built status by the A/E.

3. CxA Review and Approval. Prior to substantial completion, the CxA shall review the O&M manuals, documentation and redline as-builds *for systems that were commissioned* to verify compliance with the *Specifications.* The CxA will communicate deficiencies in the manuals to the PM or A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the PM or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Commissioning Record in O&M Manuals.

1. The CxA is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the GC, to be included with the O&M manuals. Three copies of the manuals will be provided. The format of the manuals shall be:

   a. *Tab I-1* Commissioning Plan

   b. *Tab I-2* Final Commissioning Report (see (B.2) below)

   c. *Tab 01* System Type 1 (chiller system, packaged unit, boiler system, etc.)

   d. *Sub-Tab A* Design narrative and criteria, sequences, approvals for Equipment 1

   e. *Sub-Tab B* Startup plan and report, approvals, corrections, blank pre-functional checklists

   f. *Colored Separator Sheets*—for each equipment type (fans, pumps, chiller, etc.)

   g. *Sub-Tab C* Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.

   h. *Tab 02* System Type 2.....repeat as per System 1

2. Final Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece

of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

3. Current Facilities Requirements and Operations and Maintenance Plan - Systems Manual
Prepare and maintain a current facilities requirements and operations and maintenance plan that contains the information necessary to operate the building efficiently. The plan must include the following:
    - A sequence of operations for the building
    - The building occupancy schedule
    - Equipment run-time schedules
    - Setpoints for all HVAC equipment
    - Set lighting levels throughout the building
    - Minimum outside air requirements
    - Any changes in schedules or setpoints for different seasons, days of the week, and times of day
    - A systems narrative describing the mechanical and electrical systems and equipment
    - A preventive maintenance plan for building equipment described in the systems narrative
    - A commissioning program that includes periodic commissioning requirements, ongoing commissioning tasks, and continuous tasks for critical facilities.

4. Other documentation will be retained by the CxA.

3.9 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

1. The CxA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the Subs and vendors who have training responsibilities.

2. In addition to these general requirements, the specific training requirements of Owner personnel by Subs and vendors is specified in Division 15 and 16.

3. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. The plan will cover the following elements:

    a. Equipment (included in training)

    b. Intended audience

    c. Location of training

    d. Objectives

    e. Subjects covered (description, duration of discussion, special methods, etc.)

    f. Duration of training on each subject

    g. Instructor for each subject

h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)

i. Instructor and qualifications

4. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

5. The CxA develops an overall training plan and coordinates and schedules, with the PM and GC, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the PM using a standard form. The PM also signs the approval form.

6. At one of the training sessions, the CxA presents a __1__ hour presentation discussing the use of the blank functional test forms for re-commissioning equipment.

7. Video taping of the training sessions will be provided by the GC with tapes cataloged by the GC and added to the O&M manuals.

8. The mechanical design engineer shall at the first training session present the overall system design concept and the design concept of each equipment section. This presentation shall be __2___ hours in length and include a review of all systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water or heat rejection systems, heating systems, fuel oil and gas supply systems, supply air systems, exhaust system and outside air strategies.

3.10 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) specified in Section 23 08 11 shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.

3.11 WRITTEN WORK PRODUCTS

A. The commissioning process generates a number of written work products described in various parts of the *Specifications.* The *Commissioning Plan,* lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

Product	Developed By
1. Final commissioning plan	CxA
2. Cx meeting minutes	CxA
3. Commissioning schedules	CxA with GC and CM
4. Equipment documentation submittals	Subs

5.	Sequence clarifications		Subs and A/E as needed
6.	Pre-functional checklists		CxA
7.	Startup and initial checkout plan		Subs and CxA (compilation of existing documents)
8.	Startup and initial checkout forms filled out	Subs	
9.	Final TAB report		TAB
10.	Issues log (deficiencies)		CxA
11.	Commissioning Progress Record		CxA
12.	Functional test forms		CxA
13.	Systems Manual		CxA
14.	Filled out functional tests		CxA
15.	O&M manuals	Subs	
16.	Overall training plan		CxA and CM
17.	Specific training agendas		Subs
18.	Final commissioning report	CxA	
19.	Misc. approvals		CxA

3.12 IAQ TESTING

A. The general contractor will assist the commissioning agent in scheduling the IAQ testing. Prior to the testing all finishes shall be complete for at least 72 hours, the building will be purged with as much conditioned outside air as possible and the building will be unoccupied.

B. The building will remain unoccupied during the testing (approximately 8 hours) and the HVAC systems will be run normally as if the building was occupied.

C. The cost of retesting will be born by the offending party if the IAQ test is unsuccessful.

END OF SECTION

DIVISION

03

CONCRETE

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Divisions 00 & 01 Specifications apply to this Section.

1.2 SUMMARY

A. Section Includes: Cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes, for the following:
   1. Pile caps.
   2. Foundations, grade beams, and walls.
   3. Floor slabs.
   4. Equipment pads and bases.

B. Related Sections:
   1. Division 01Section – “Submittal Procedures”.
   2. Division 22: Equipment bases.
   3. Division 5 Section: “Steel Decking”.
   4. Division 31 Section: “Steel Pipe Piles”

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's descriptive literature and application recommendations for reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, and other proprietary materials and items if requested by Architect.

B. Shop Drawings: Submit details for fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, spacing, bent bar diagrams, and arrangement of concrete reinforcement, ties, and stirrups. Include special reinforcing for openings through concrete.

C. Mix Design Data: Submit laboratory test reports or evaluation reports for concrete materials and each proposed concrete mix.
   1. The Contractor shall engage a testing agency acceptable to Architect to perform material evaluation tests and to design concrete mixes.
   2. Submit written mix design data at least 15 days prior to scheduled start of concrete placement.
   3. Do not begin concrete production until mix designs have been reviewed by the Architect.
   4. Submit aggregate test data or LADOTD acceptance information indicating no potential for alkali-silica reactions.

D. Proposed construction joint locations at slabs.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following, except where more stringent requirements are shown or specified:
   1. ACI 301, "Specifications for Structural Concrete for Buildings".

2. ACI 318, "Building Code Requirements for Reinforced Concrete" IBC 2021 referenced Edition.
3. ACI 315, “Manual of Standard Practice for Detailing Reinforced Concrete Structures”.
4. 2021 International Building Code (IBC).
5. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".

B. Concrete Testing Service: As specified in PART 3 of this Section.

PART 2 – PRODUCTS

2.1 FORM MATERIALS

A. General: Furnish form materials capable of supporting construction loads in addition to weight of fresh concrete, without displacement or excessive deflection.

B. Forms for Exposed Concrete: Metal, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints. Provide Class A formwork.

C. Forms for Unexposed Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit. Provide Class C formwork.

C. Form Release Agent: Commercial formulation that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties that will leave no metal closer than 1-1/2 inches to the exposed concrete surface.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric sheets.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and positioning reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
   1. For slabs-on-grade, use supports with sand plates or horizontal runners.
   2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I/II.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: Normal-Weight, ASTM C 33, except local aggregates proven by special tests or actual service to produce concrete of adequate strength and durability may be used, subject to acceptance by Architect.

D. Water: Potable.

E. Slag: Not acceptable.

F. Micro-Fiber Reinforcement:
   1. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, ½ to 1-inch (13 to 25mm) long.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Fibrillated Fibers:
         1) Fibrasol F; Axim Concrete Technologies
         2) Fibermesh; Fibermesh, Div. of Synthetic Industries

3) Forta CR; Forta Corporation
4) Grace Fibers; W.R. Grace & Co., Construction Products Division

2.4 ADMIXTURES

A. General: Use only admixtures that have been accepted in mix designs. Use admixtures in accordance with manufacturer's directions and recommendations. Use water-reducing admixture in concrete, as necessary for placement and workability. Provide concrete admixtures that are compatible with other concrete ingredients and that contain not more than 0.1 percent chloride ions.
1. Use accelerating admixture in concrete placed at ambient temperatures below 50 deg F (10 deg C).
2. Use high-range water-reducing admixture (super plasticizer) in pumped concrete, concrete with water-cement ratios below 0.50, and elsewhere only as instructed.
3. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated, to result in concrete at point of placement having total air content from 2 to 4 percent.
4. Provide a shrinkage inhibiting admixture at all slabs.
5. Provide a shrinkage inhibiting admixture and micro-fiber reinforcing at all exterior pile-supported slabs.

B. Air-Entraining Admixture: ASTM C 260.

1. Products: Subject to compliance with requirements, provide one of the following:
a) Air-Mix or Perma-Air, Euclid Chemical Co.
b) Darex AEA or Daravair, W.R. Grace & Co.
c) Master Air AE-90, BASF Corporation.
d) Sika AER, Sika Corp.

C. Water-Reducing Admixture: ASTM C 494, Type A.

1. Products: Subject to compliance with requirements, provide one of the following:
a) Eucon WR-75, Euclid Chemical Co.
b) WRDA, W.R. Grace & Co.
c) Master Pozzolith, BASF Corporation.
d) Plastocrete 161, Sika Corp.

D. High-Range Water-Reducing Admixture: (Superplasticizer) ASTM C 494, Type F or Type G. All pumped concrete shall contain a high range water-reducer (Superplasticizer) chloride free.

1. Products: Subject to compliance with requirements, provide one of the following:
a) Eucon 37, Euclid Chemical Co.
b) WRDA 19 or Daracem, W.R. Grace & Co.
c) Master Rheobuild 1000 or Master Glenium, BASF Corporation.
d) Sikament 300, Sika Corp.

E. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

1. Products: Subject to compliance with requirements, provide one of the following:
a) Accelguard 80, Euclid Chemical Co.
b) Daraset, W.R. Grace & Co.
c) Master Set AC-534 or Master Set FP-20, BASF Corporation.

F. Water-Reducing, Retarding Admixture: ASTM C 494, Type D

1. Products: Subject to compliance with requirements, provide one of the following:

a) Eucon Retarder 75, Euclid Chemical Co.
b) Daratard-17, W.R. Grace & Co.
c) Master Set R or Master Set DELVO, BASF Corporation.
d) Plastiment, Sika Corporation.

G. Shrinkage Inhibiting Admixture: Shrinkage reducing admixture shall be Master LIFE SRA 20 manufactured by BASF Corporation or pre-bid approved equal. Dosage rate shall be in accordance with the manufacturer's recommendations for the designated usage with a maximum shrinkage allowance of .025% but not less than 1.5 gal./yd.

H. Crystalline waterproofing admixture shall be Xypex, Caltite, or prior approved equal. Admixture is required for concrete mixes at elevator pit walls, elevator pit slabs, curbs, pool slabs & walls, and where otherwise indicated. Dosage shall be as recommended by the manufacturer for a water head pressure of 6ft. minimum.

2.5 RELATED MATERIALS

A. Expansion Joint Filler: Non-bituminous, non-extruding cork or rubber joint filler, ASTMD1752. Joint sealants are specified in Division 07.

B. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophilic material for adhesive bonding to concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
a) Volclay Waterstop-RX; Colloid Environmental Technologies Co.
b) Conseal CS-231; Concrete Sealants Inc.
c) Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.
d) Hydrotite; Greenstreak.
e) Mirastop; Mirafi Moisture Protection, Div. of Royal Ten Cate (USA), Inc.
f) Adeka Ultra Seal; Mitsubishi International Corporation.
g) Superstop; Progress Unlimited Inc.

C. Underslab Polyethylene Sheet: Provide 15 mil STEGO-WRAP with manufacturer's pressure sensitive adhesive tape beneath interior slabs. 8 mil polyethylene sheet beneath exterior pile-supported slabs.

D. Concrete Dressing: ARDEX CD Concrete Dressing.

2.6 CURING MATERIALS

A. Absorptive Cover: Burlap cloth weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

B. Moisture-Retaining cover: Waterproof paper, polyethylene film or polyethylene-coated burlap, complying with ASTM C 171.

C. Curing Compound: ASTM C309 dissipating, water-based and compatible with floor coverings and coatings.

2.7 SEALER

A. Seal Hard – L&M Chemical Co. or Ashford Formula – Curecrete Chemical Co., Inc.

2.8 ADHESIVE

A. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a) HIT-HY 200, HILTI.
      b) SET-XP, Simpson Strong-Tie
      c) Sikadur 32 Hi-Mod, Sika Corp.

2.9 PROPORTIONING AND DESIGNING MIXES

A. General: Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. Comply with "SUBMITTALS" provisions in PART 1 of this Section.
   1. Limit use of fly ash to not exceed 25 percent of cement content by weight.
   2. Limit water/cement ratio of concrete exposed to freezing to 0.45.
   3. Limit water/cement ratio of first floor slab concrete to 0.45.

B. Slump Limits: Design mixes for concrete slump at point of placement as follows:
   1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
   2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.
   3. Concrete containing high-range water-reducing admixture (super plasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-3-inch slump concrete.
   4. Other concrete: Not more than 4 inches.

C. Adjustment to Concrete Mixes: Adjust mix design when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Do not use revised mix designs until test data and strength results have been submitted to and accepted by the Architect.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Use ready-mixed concrete throughout, unless otherwise approved by the Architect. Comply with requirements of ASTM C 94, and as specified.

B. Hot Weather Mixing: When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 – EXECUTION

3.1 GENERAL

A. Coordination: Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

B. Tolerances: Control form construction, reinforcement placement, and placing and finishing concrete to meet the following requirements in the completed construction. Provide more stringent tolerances where required at interfaces with adjoining materials as required to achieve the indicated details of construction.

   1. Slab Surfaces – Unless otherwise indicated the maximum variation from true plane and levelness of the first-floor slab shall be as follows: Ff25; Fl20. Coordinate more stringent flatness and levelness requirements at medical equipment with the appropriate vendors.

   2. Other Exposed Surfaces and Edges -
      a) Cross section dimension: Minus ¼", plus ½".

b) Variation from indicated level: ±¼" in 10 feet; ± ½" max.
c) Variation from plumb: ±¼" in 10 feet; ±½" max.
d) Variation from true line: ±¼" in 10 feet; ±3/8" in 20 feet; ±½" max.
e) Alignment of columns and walls (bottom versus top): ±½".
f) Location in plan: ±½" in 20 feet; ±3/4" max.

3. Reinforcement Placement –
   a) Concrete cover: Plus ¼", minus 0.
   b) Spacing of parallel bars: ±¼".
   c) Length of bars: ±1".
   d) Vertical or horizontal displacement: One bar diameter.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to resist wind loads and to support vertical, lateral, static, and dynamic loads of concrete and subsequent operations until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Formwork Tolerances: Maintain formwork construction tolerances and surface irregularities within ACI 347 limits:
   1. Provide Class A tolerances for concrete surfaces exposed to view.
   2. Provide Class C tolerances for other concrete surfaces.

C. Embedded Items: Set and build into formwork reglets, dovetail slots, anchorage devices, sleeves, and other embedded items for work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

D. Formwork Construction: Fabricate forms for easy removal without hammering or prying against concrete surfaces. Kerf wood inserts for keyways, reglets, recesses, and similar features for easy removal.
   1. Provide necessary temporary openings for clean-outs and inspections before and during concrete placement. Locate temporary openings at inconspicuous locations.
   2. Chamfer exposed corners and edges as indicated.
   3. Apply form release agent or wet forms as necessary.

E. Provisions for Other Trades: Provide openings in formwork to accommodate work of other trades. Accurately place and securely support sleeves and other items built into forms.
   1. The forming Contractor shall coordinate slab and beam blockouts and embedded weld plates with the exterior wall manufacturer.

F. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and securely support screed strips for use with strike-off templates or compacting-type screeds.

G Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces prior to concrete placement. Retighten forms and bracing during placement if necessary to prevent mortar leaks and maintain proper alignment.

H. Under Slab Vapor Barrier: Continuous installation under slabs with continuous taped seams and taped penetrations.

I. Earth Cuts as Forms: All concrete construction must be non-earth formed. Earth cuts will only be acceptable in lieu of forms where Drawings indicate slanted sides of a concrete member.

The Contractor shall provide necessary dewatering or dry bottoms, without additional cost to the Owner.

3.3 REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for details and methods of reinforcement placement and supports.
   1. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
   2. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, and wire ties. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
   3. Maintain minimum coverage as indicated.

B. Welded Wire Fabric: Install welded wire fabric sheets in lengths as long as practicable. Lap two full squares and tie splices with wire. Offset laps of adjoining widths to prevent continuous laps in both directions.

C. Micro-Fiber Reinforcement: Add to mix at a rate of 1.5 lb. per cubic yard. Fiber reinforcement is required in all exterior exposed-to-view, pile supported concrete slabs.

D. Deformed Bar Anchors: Weld per manufacturer’s printed instructions.

3.4 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure.
   1. Provide formed keyways at least 1-1/2 inches deep in construction joints.
   2. Place construction joints perpendicular to main reinforcement and continue reinforcement across construction joints unless indicated otherwise.
   3. Use bonding agent on concrete surfaces that will be joined with fresh concrete.

3.5 CONCRETE PLACEMENT

A. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete". Deposit concrete continuously so that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified.
   1. Deposit concrete to avoid segregation at its final location.
   2. Maintain reinforcing in proper position during concrete placement.

B. Consolidation: Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping in compliance with ACI 309. Do not use vibrators to transport concrete inside forms. Limit vibration to time necessary to consolidate concrete and embed reinforcement and other items without causing mix to segregate.

C. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

D. Cold-Weather Placement: Comply with ACI 306 and the following. Protect concrete work from physical damage or reduced strength from frost, freezing actions, or low temperatures.
   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

E. Hot-Weather Placement: Comply with ACI 305 and the following. Protect concrete work from reduced strength and impaired quality from too-rapid drying and elevated temperature.
1. Water-fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
2. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, if acceptable to Architect.

3.6 FORMED SURFACES FINISHES

A. Verify formed surface finish requirements with Project Architect prior to construction.

B. Rough-Formed Finish: Provide concrete surfaces not exposed to view in the finished construction with texture imparted by form material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding ¼ inch in height rubbed down or chipped off.

C. Smooth-Formed Finish: Provide concrete surfaces exposed to view or to be covered with a coating or covering material applied directly to concrete (such as waterproofing, dampproofing, veneer plaster, or similar system), with an as-cast surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective concrete areas. Fins and other projections shall be completely removed and smoothed.

D. Smooth-Rubbed Finish: Provide smooth-rubbed finish within 24 hours after form removal on concrete surfaces to be painted or left exposed at occupied rooms and spaces in the completed construction. In addition to smooth-formed finish as specified, moisten concrete surfaces and rub with carborundum brick or another abrasive to produce a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces.

F. Exterior, exposed-to-view, vertical concrete surfaces at grade beams, walls, and slab edges shall be surfaced with the specified concrete dressing product. The concrete dressing shall extend 6” below finish grade elevations to provide a uniform visual appearance as a final product. Preparation and installation shall be in strict conformance with the product manufacturer’s printed instructions.

3.7 MONOLITHIC SLAB FINISHES

A. General: Verify required slab finishes with Architect and flooring specifications before concrete is placed. At epoxy floor areas provide slab finish compatible with manufacturer and installer requirements (refer to epoxy flooring specification). Slope surfaces uniformly to drains where required.

B. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing and roof insulation, or sand-bed terrazzo; and where indicated.
   1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared and concrete has stiffened sufficiently to permit operation of power-driven floats. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Produce a uniform, smooth, granular texture.
   2. Finish surfaces to tolerances specified. Cut down high spots and fill low spots; refloat such corrections.

D. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, adhesive-set ceramic or quarry tile, paint, or other thin-film coating system or adhesive-set finish.
   1. After floating, begin first trowel-finish operation using a power-driven trowel when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance.
   2. Finish surfaces to tolerances specified. After concrete has hardened, grind smooth surface defects that would telegraph through applied floor covering system.

E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

F. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated. Uniformly slope exterior surfaces to eliminate "bird baths". Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route.

G. Provide specified Sealer and Densifier at concrete slabs indicated as “sealed concrete” on the Architectural floor finish schedules or drawings.

3.8 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations. Comply with diagrams or templates of manufacturer furnishing machines and equipment.

D. Moisture Testing: Moisture testing shall be performed in accordance with floor covering and coating specifications and manufacturer’s requirements.

3.9 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from physical damage, premature drying and excessive cold or hot temperatures.

B. Initial Curing: Begin curing as soon as free water has disappeared from concrete surface after placing and finishing. Continue curing for not less than 7 days.

C. Curing Methods: Cure concrete by one or a combination of the following methods.
1. Continuous water-fog spray, or completely cover with specified absorptive cover, thoroughly saturated with water and kept continuously wet, with sides and ends lapped 4 inches.
2. Cover with moisture-retaining cover with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound in compliance with manufacturer's requirements.

D. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. After forms are removed, continue curing by methods specified above, as applicable.

3.10 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar elements, may be removed 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may be removed when concrete has attained at least 75 percent of specified 28-day compressive strength.

B. Form Re-Use: Clean and repair surfaces of forms to be reused. Split, frayed, delaminated, or otherwise damaged form material will not be acceptable. Apply new form-coating compound.

C. Extending Formed Surfaces: When forms are extended for successive concrete placement, thoroughly clean forms and in-place concrete surfaces, remove fins and latence, and tighten forms to close joints. Align and secure forms to avoid offsets.

3.11 CONCRETE REPAIRS

A. Patching Defective Areas: Immediately after removing forms, repair and patch defective areas with cement mortar consisting of one-part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only the amount of water necessary for handling and placing.
1. Patch voids over ¼ inch in any dimension and holes left by tie rods and bolts. Cut down to solid concrete, but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface.
2. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
3. Correct high areas in formed and unformed surfaces by grinding after concrete has cured at least 14 days.
4. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.

B. Replacing Defective Areas: Remove and replace defective concrete if defects cannot be satisfactorily patched. Defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
   2. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

3.12 FIELD QUALITY CONTROL TESTING

A. General: The Independent Testing Lab shall perform tests and submit test reports. Minimum testing will be as specified below. Additional testing may be ordered by the Owner or Architect.

B. Minimum Testing: Sampling and testing for quality control during concrete placement will include the following.
   1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
   2. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
   3. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed.
   4. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50-cu. yd. more than the first 50 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

C. Random Sampling: When specified frequency of testing will provide fewer than five sets of cylinders for a given class of concrete, obtain samples and conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

D. Reporting: Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests.

E. Additional Tests: The testing agency may make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect, by cored cylinders complying with ASTM C 42, or by other methods as directed.

F. Flatness-Levelness: Flatness and Levelness testing at the first floor slab is required. Levelness testing is required at slabs on steel deck.

END OF SECTION 03 30 00

SECTION 03 33 01 – SHEET VAPOR BARRIERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vapor barrier and installation accessories for installation under concrete slabs.

B. Related Sections:

1. Section 03 30 00 – Cast-in-Place Concrete.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E1745 – 11, *Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.*
2. ASTM E1643 – 11, *Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.*

1.3 SUBMITTALS

A. Quality Assurance/Control Submittals:

1. Product Data for vapor barrier and accessories.
2. Manufacturer's installation instructions for placement, seaming, and penetration repair.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Vapor barrier shall meet the following requirements:

1. Permeance: Less than 0.01 perms [grains/(ft²·hr·in. Hg)] when tested in accordance with ASTM E1745, including mandatory conditioning procedures per Section 7.1 (7.1.1–7.1.5).
2. Strength: ASTM E1745, Class A.
3. Minimum Thickness: 15 mils.

B. Acceptable Products: Subject to compliance with requirements, provide one of the following:

1. Stego Industries – Stego Wrap Vapor Barrier.
2. Reef Industries – Vaporguard.
3. Sundance Inc. – Sundance Vapor Barrier.
4. Or approved equal.

2.2 ACCESSORIES

A. Seam/Penetration Tape: Manufacturer's standard tape for seaming overlapping sheets and sealing penetrations.

B. Mastic: Manufacturer's standard mastic for sealing around penetrations too tight or small to receive tape.

C. Penetration/Edge Seal: Manufacturer's standard termination system for sealing vapor barrier edges in accordance with manufacturer's installation instructions (e.g., Stego Crete Claw).

PART 3 – EXECUTION

3.1 PREPARATION

A. Ensure subsoil is approved by Architect or Geotechnical Engineer.

B. Level and compact base material prior to vapor barrier installation.

3.2 INSTALLATION

A. Install vapor barrier in accordance with ASTM E1643 and manufacturer's instructions.

B. Unroll vapor barrier with the longest dimension parallel to the direction of concrete placement; face laps away from the direction of placement when possible.

C. Extend vapor barrier over footings and grade beams to the extent acceptable to the Structural Engineer, or terminate at impediments such as dowels or waterstops.

D. Seal perimeter of vapor barrier using one of the following:

1. Seal to slab perimeter/edge with manufacturer's termination system such as Stego Crete Claw; remove dirt, debris, and mud from termination prior to concrete placement.

2. Seal to footing/grade beam with double-sided tape, termination bar, or both.

E. Overlap joints a minimum of 6 inches and seal with manufacturer's tape.

F. Apply tape/termination system only to clean and dry vapor barrier surfaces.

G. Seal all penetrations (including pipes) per manufacturer's instructions. No penetrations are permitted except for reinforcing steel and permanent utilities.

H. Repair damaged areas by cutting patches of vapor barrier to overlap the damaged area by a minimum of 6 inches on all sides; tape all seams.

I. Protect installed vapor barrier from damage until concrete placement.

END OF SECTION 03 30 01

SECTION 03 54 00 – CEMENT-BASED FINISHING UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. This is the recommended specification for ARDEX SD-F Feather Finish, Self-Drying, Cement-Based Finishing Underlayment

2. ARDEX SD-F Feather Finish, Self-Drying, Cement-Based Finishing Underlayment.

B. Related Sections include the following:

1. Division 09 Flooring Sections

1.3 QUALITY ASSURANCE

A. Provide ARDEX SD-F Feather Finish from as manufactured by ARDEX INC., 400 Ardex Park Drive, Aliquippa, PA 15001.

B. Underlayment shall be able to be installed from a true featheredge to ½" thick over large areas and to any thickness in well-defined areas such as filling holes or gouges and for making ramps.

C. Underlayment shall not require that the substrate be primed.

D. Underlayment shall be formulated with a Portland cement matrix, which develops a compressive strength of 4200 psi when tested in accordance with ASTM C109/mod. (air-cure only).

E. Underlayment shall be able to be covered by most finish flooring materials as soon as the surface hardens (usually within 1 hour). Parquet, athletic flooring and floor covering requiring specialized adhesives can be installed after 16 hours.

F. Underlayment shall not require the addition of latex or any additive other than potable water.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in their original, unopened packages and protect from extreme temperatures and moisture. 03540-2 10/8/12

1. SITE CONDITIONS

B. ARDEX SD-F is a cementitious material. Observe the basic rules of concrete work. Do not install below 50°F surface temperature. Install quickly if floor is warm and follow hot weather precautions available from the ARDEX Technical Service Department. Never mix with cement or additives other than ARDEX-approved products.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The Portland cement-based, self-drying, trowelable finishing underlayment shall be ARDEX SD-F Feather Finish.

B. No primer required over all recommended substrates.

C. Water shall be clean, potable, and sufficiently cool (not warmer than 70°F).

2.2 MIX DESIGNS

A. Mix ARDEX SD-F powder with water to the desired trowelable consistency. The recommended mixing ratio is 2 parts powder to 1 part water by volume.

B. Apply ARDEX SD-F to the prepared substrate using a steel trowel using sufficient pressure to achieve the desired thickness and to provide a perfect featheredge, where necessary.

C. Install ARDEX SD-F from a true featheredge up to a maximum thickness of ½ inch or as required to fill gouges, scratches or small holes.

D. When the underlayment can be worked on without adversely affecting the surface, proceed with the installation of floor covering. Note: The surface of the ARDEX SD-F does not have to be dry to receive ceramic tile, carpet, or vinyl floor coverings. It only needs to be hard enough to permit application of the adhesive with a notches trowel without marking the surface. Typical times range from 15 minutes to 1 hour depending upon ambient conditions.

PART 3 – EXECUTION

3.1 PREPARATION

A. All subfloors, regardless of material, must be solid, sound and thoroughly cleaned.

B. All concrete subfloors must be clean, and free of all oil, grease, dirt, curing compounds, and any substance, which might act as a bondbreaker. Mechanically clean, if necessary, using shot blasting or other. Acid etching and the use of sweeping compounds or solvents are not acceptable.

C. Non-porous subfloors, such as ceramic tile and terrazzo must be clean and free of all sealers, waxes, or other surface treatments, which may act as a bondbreaker. Professionally strip where necessary.

D. Cutback and other non-water soluble adhesive residues must be thin and well bonded to the subfloor. Note: The use of ARDEX SD-F over adhesive residues is recommended for projects only where the adhesive residue may interfere with the performance of the new flooring. For a permanent barrier to migration of adhesive residues on commercial projects, use ARDEX K-15 + E-25 or ARDEX SD-L following the Recommended Work Practices of the Resilient Floor5 Covering Institute.

E. Subfloors shall be tested and corrected for moisture or any other conditions which could affect the performance of the underlayment or finished floor covering.

3.3 PROTECTION

A. Prior to the installation of the finish topping, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, Masonite or other suitable protection course.

END OF SECTION 03540

DIVISION

04

MASONRY

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Miscellaneous masonry accessories.

B. Related Sections:
1. Division 03 Section 03 30 00 "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Division 05 Section 05 12 00 "Structural Steel Framing" for furnishing steel lintels and shelf angels, and for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.
1. Density Classification: Normal weight unless otherwise indicated.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Exposed Faces: Ground Face
4. Compressive Strength: 19000psi minimum average.

2.3 STONE MASONRY

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Stone Masonry: Facing brick complying with ASTM C 216.
1. Basis-of-Design Products: Cordova Stone Masonry Units.
2. Color: TBD
3. Texture: Burnished and split face

2.4 MORTAR AND GROUT MATERIALS

A. Use type 'N' mortar for setting mortar and pointing mortar complying with ASTM C 270.
   1. Do not use admixtures, including pigments, air entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds, or other admixtures unless otherwise indicated.
   2. Do not use calcium chloride in mortar or grout.
   3. Provide mortar achieving 4000psi at 28 days, with a 7 to 8 inch slump; premixed type in accordance with ASTM C 94, mixed in accordance with ASTM C 476 fine and coarse grout.

B. Masonry Cement: ASTM C 91.
   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Holcim (US) Inc.; Mortamix Masonry Cement.
      b. Lafarge North America Inc.; Magnolia Masonry Cement.
      c. Lehigh Cement Company; Lehigh Masonry Cement.

C. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Aggregate for Grout: ASTM C 404.

E. Water: Potable.

F. Color: Match existing building.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
   1. Interior Walls: Hot-dip galvanized, carbon steel.
   2. Exterior Walls: Hot-dip galvanized, carbon steel.
   3. Wire Size for Side Rods: 0.187-inch diameter.
   4. Wire Size for Cross Rods: 0.187-inch diameter.
   5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Recycled Content of Steel Products: Provide steel products with an average recycled content so that post-consumer recycled content plus one-half pre-consumer recycled content is not less than 75 percent.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
   2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
   3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
   4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
2. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
3. Wire: Fabricate from 3/16-inch-diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel wire.
2. Manufacturers: Subject to requirements:

a. Basis of Design - HB Veneer Anchors Thermal 2-Seal Tie or approved equal.
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E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 01.05-inch-thick, steel sheet, galvanized after fabrication.

a. 0.064-inch-thick, galvanized sheet may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

2.7 MASONRY DRAINAGE MAT

A. Masonry Drainage Mat: Fluid-conducting, non-absorbent, mold and mildew resistant, non-woven polymer mesh designed for substantially continuous installation in masonry cavities.
1. Basis-of-Design: Subject to other requirements, provide Archovations, inc.; CavClear or comparable product.
2. Thickness: ¾ inches to allow no more than 3/8” gap between the mat and masonry wythe.

B. Weep Vents: Non-woven polymer mesh with M-notched bottom placed above every horizontal break in masonry drainage cavities.
1. Basis-of-Design: Subject to other requirements, provide Archovations, inc.; CavClear Weep Vents or comparable product.

2.8 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.

C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

D. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. For interior masonry, use colored masonry cement mortar.

    a. Color: As selected by Architect from masonry cement manufacturer’s full range.
4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type N.
2. For reinforced masonry, use Type N.
3. For mortar parge coats, use Type N.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored mortar cement product.
   1. Pigments shall not exceed 10 percent of mortar cement by weight.
   2. Mix to match Architect's sample.
   3. Application: Use pigmented mortar for exposed mortar joints with the following units:

      a. Pre-faced CMUs.

E. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 4000 psi.
   3. Provide grout with a slump of 7 to 8 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. Set face brick in bed joints of thickness so as to align with concrete masonry unit backers.
   2. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   3. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   4. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
   6. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay face brick in running bond, and exposed CMU and prefaced CMU in stack bond; refer to bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
   3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
   1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
   1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:
1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 1/2 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches, for brick-size units, and 24 inches, for block-size units, and less than 144 inches are shown without structural steel or other supporting lintels. Provide steel lintels for spans greater than 144 inches with no steel indicated; coordinate with Architect.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

7. Clean stone trim to comply with stone supplier's written instructions.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cast stone trim including the following:

a. Window sills.
b. Watertables.
c. Parapet/Roof edge caps.

B. Related Sections:

1. Division 04 Section 04 20 00 "Unit Masonry" for installing cast stone units in unit masonry.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Initial Selection: For colored mortar; sample can double for Section 04 20 00 — “Unit Masonry.”

D. Samples for Verification:

1. For each color and texture of cast stone required, 10-inches min. square in size.

2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicated types and amounts of pigments used.

E. Full-Size Samples: For each shape of cast stone unit required.

1. Make available for Architect's review at Project site.
2. Make Samples from materials to be used for units used on Project immediately before beginning production of units for Project.
3. Approved Samples may be installed in the Work.

F. Qualification Data: For manufacturer.

1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.

G. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364.

1. Provide test reports based on testing within previous two years.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute, the Architectural Precast Association, or the Precast/Prestressed Concrete Institute for Group A, Category AT.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

E. Mockups: Furnish cast stone for installation in mockups specified in Division 04 Section "Unit Masonry."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with non-staining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.6 PROJECT CONDITIONS

A. Hot-Weather Requirements: Comply with hot-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

A. General: Comply with ASTM C 1364 and the following:

B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast stone color indicated.

C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required cast stone textures and colors.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required cast stone textures and colors.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

F. Admixtures: Use only admixtures specified or approved in writing by Architect.

1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.

G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than of cast stone material.

1. Epoxy Coating: ASTM A 775/A 775M.
2. Galvanized Coating: ASTM A 767/A 767M.

H. Embedded Anchors and Other Inserts: Fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

2.2 CAST STONE UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Stone Legends, Inc.
2. Melton Classics, Inc.
3. Continental Cast Stone.
4. New Orleans Cast Stone, LLC.
5. Alforthish Cast Stone Products.

6. Intrinsic Cast Stone, co.

B. Regional Materials: Provide cast stone units that have been manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

C. Recycled Content: Provide cast stone products with an average recycled content with postconsumer recycled content plus one-half of preconsumer recycled content being not less than 30 percent.

D. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.

1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.

E. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

F. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8-inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than ¼ inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

G. Cure units as follows:

1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

a. No fewer than five days at mean daily temperature of 70 deg F or above.
b. No fewer than six days at mean daily temperature of 60 deg F or above.
c. No fewer than seven days at mean daily temperature of 50 deg F or above.
d. No fewer than eight days at mean daily temperature of 45 deg F or above.

H. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

I. Colors and Textures: As selected by Architect from manufacturer's full range.

2.3 MORTAR MATERIALS

A. General: Refer to Mortar Materials section in Section 04 20 00 – “Unit Masonry” for mortar materials. Use same mixture for cast stone as unit masonry.

2.4 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

B. Dowels: ½-inch-diameter, round bars, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.5 MORTAR MIXES

A. Comply with requirements in Division 04 Section 04 20 00 "Unit Masonry" for mortar mixes.

2.6 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C 1364.

1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

A. Install cast stone units to comply with requirements in Division 04 Section 04 20 00 "Unit Masonry."

B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Coordinate installation of cast stone with installation of flashing specified in other Sections.

C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

D. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Set units with joints 3/8” wide unless otherwise indicated – coordinate with surrounding joint widths.
2. Build anchors and ties into mortar joints as units are set.
3. Fill dowel holes and anchor slots with mortar.

4. Fill collar joints solid as units are set.
5. Build concealed flashing into mortar joints as units are set.
6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
7. Keep joints at shelf angles open to receive sealant.

E. Rake out joints for pointing with mortar to depths of not less than ¾-inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8-inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

H. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated. Refer to Section 04 20 00 “Unit Masonry”

1. Keep joints free of mortar and other rigid materials.
2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less than ½”.
4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Division 07 Section "Joint Sealants."

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/8-inch in 10-feet, ¼-inch in 20-feet, or ½-inch maximum.

B. Variation from Level: Do not exceed 1/8-inch in 10-feet, ¼-inch in 20-feet, or ½-inch maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16-inch, except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 72 00

DIVISION

05

METALS

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Divisions 00 & 01 Specifications apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Scope: The Contract Drawings, including schedules, notes and details, show size and location of members, typical connections, and type of steel required. This Section includes all structural steel work as defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as shown on Drawings.

B. Related Sections:

1. Division 01 Section – “Submittal Procedures”.
2. Testing Laboratory Services.
3. Cast-In-Place Concrete.
4. Steel Decking.

C. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated. Unless otherwise noted on the Drawings, all beam end shear connections shall develop one-half of the total allowable uniform load capacity of the beam for the given span in the AISC Manual of Steel Construction Beam Tables. Beam end shear connections for beams with shear studs shall develop three-quarters of the total allowable load capacity of the beam for the given span in the AISC Manual of Steel Construction Beam Tables. Greater loadings will be shown on the Drawings.

1. The design adequacy of any detail configuration of connections developed by the fabricator as part of the preparation of Shop Drawings and fabrication of material is not the responsibility of the Owner, Architect, or Architect's consultants.
2. Paragraph 4.2.1 of the AISC "Code of Standard Practice" referenced herein is hereby amended accordingly to eliminate the acceptance of this responsibility by the Owner, the Architect, and the Architect's consultants as a result of the review and approval of Shop Drawings.

1.3 SUBMITTALS

A. General: Submit the following: (Hard copies are required.)

B. Product Data: Producer's or manufacturer's specifications, installation instructions, laboratory test reports and other data to show compliance with specifications (including specified standards) for following products:

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
2. High-strength bolts (each type), including nuts and washers.
3. Structural steel primer paint.
4. Shrinkage-resistant grout.

C. Shop Drawings (three full-size hard copies are required to be submitted): Complete details and schedules for fabrication and assembly of structural steel members.

1. Include details of cuts, connections, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols. Show size, length, and type of each shop and field weld.
3. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other Sections.
4. Provide connection design calculations, for all member connections not fully detailed on the Drawings, prepared and sealed by a Louisiana licensed civil or structural engineer shall be submitted concurrent with the shop drawings. Calculations shall be project specific and shall reference member piece detail numbers on the shop drawings.
5. Shop drawings shall be submitted only after the results of the connection design have been incorporated.

D. AISC fabricator and erector certifications.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
1. AISC "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
3. AISC "Specifications for Architecturally Exposed Structural Steel."
4. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.
5. American Welding Society (AWS) D1.1 "Structural Welding Code – Steel."
6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."
1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

C. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop and field, conducted by inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements. Promptly remove and replace materials or fabricated components which do not comply.

D. AISC Certification: Fabricator and erector shall be AISC certified for buildings.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery Schedule and Sequence:
1. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay work.

B. Storage and Handling: Comply with applicable requirements of Section 01600 and the following.
1. Store materials to permit easy access for inspection and identification.

2. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.
4. Handle materials to avoid damage to materials and other construction.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General: For work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding prior to cleaning, treating and application of surface finishes. All steel shall be produced and fabricated from sources in the United States.

B. Structural Steel Shapes: ASTM A572-50. (ASTM A992 50 KSI for wide-flange).

C. Rods and Bars: ASTM A575-50.

D. Plate: ASTM A572-50.

E. Hollow Structural Sections (HSS): ASTM A 500, Grade C.

F. Anchor Bolts: ASTM F1554, grade as indicated, weldable, non-headed type unless otherwise indicated.

G. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts. Provide either hexagonal or square, heads and nuts, except use only hexagonal units for exposed connections.

H. High-Strength Threaded Fasteners: Quenched and tempered medium-carbon steel heavy hexagon structural bolts, heavy hexagon nuts and hardened washers, complying with ASTM A 325.
1. Where indicated to be galvanized, provide bolts, nuts and washers zinc coated by hot-dip galvanizing (ASTM A 153) or by mechanical depositing (ASTM B 695, Class 50).

I. Electrodes for Welding: Comply with AWS Code.

J. Structural Steel Primer Paint:
1. SSPC - Paint 25 at all steel not exposed to view in the final structure and not scheduled to receive spray applied fireproofing or be galvanized.

K. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0-part cement to 3.0 parts sand, by volume, with minimum water required for placement of hydration.

L. Non-Metallic Shrinkage-Resistant Grout:
1. Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CE-CRD-C621.
2. Subject to compliance with requirements, products which may be used include, but are not limited to, the following:
a) Euco N. S.; Euclid Chemical Company.
b) Crystex; L & M Construction Chemicals.

c) Masterflow 713; Master Builders.
d) Sonogrout G.P.; Sonneborn Building Products.
e) Five Star Grout; U. S. Grout Corp.

M. Shear studs: Shear Studs: Shall be shear connectors with proper ferrules and accessories, especially designed to create composite action between concrete and the supporting beam. Steel for studs shall conform to ASTM A 108, Grades 1015-1020, with a minimum tensile strength of 60,000 psi. Studs shall be of uniform diameter, heads shall be concentric and normal to shaft and the weld end shall be chamfered, welds shall be solid flux.

N. Deformed Bar Anchors: Nelson D2L. (Basis-of-Design product).

2.2 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated. Structural steel exposed-to-view as a final product shall comply with AISC's "Architecturally Exposed Structural Steel (AESS)" specification including the removal of backer-bars and back-gouging at full-penetration welds.
1. Properly mark and match - mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
2. Where shop painting or galvanizing is required, complete assembly, including welding of units, before start of surface preparation for painting or galvanizing.
3. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated.

1. Bolt field connections, except where welded connections or other connections are indicated.
2. Provide high-strength threaded fasteners for all bolted connections, except where unfinished bolts are indicated.

C. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."

D. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

E. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 PROTECTIVE COATINGS

A. General: Shop paint structural steel, except galvanized items and members or portions of members to be embedded in concrete and members to receive sprayed on fire proofing. Paint steel which is partially embedded on exposed portions and initial 2" of embedded areas only. Verify primer compatibility with Division 9 requirements.

1. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.
2. Apply two (2) coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

B. Surface Preparation: After inspection and before shipping, clean steel work to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with the following Steel Structures Painting Council (SSPC) specifications:
1. Nuts and bolts are to be cleaned in accordance with SSPC-SP1 prior to shop painting to completely remove all oil, dirt, grease and all other soluble surface contaminants.

C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils for SSPC-Paint 25. Use painting methods that will result in full coverage of joints, corners, edges and exposed surfaces.

D. Galvanizing: ASTM A123/123M and ASTM A153/153M for threaded fasteners. Galvanizing repair compound shall be a two-component zinc-rich paint, ASTM A 780.

PART 3 - EXECUTION

3.1 ERECTION

A. Examination: Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces; remove bond-reducing materials and roughen to improve bond. Clean contact surfaces of base and bearing plates.
1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow it to cure. For proprietary grout materials, comply with manufacturer's instructions.

D. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust members before permanently fastening. Before assembly, clean bearing surfaces and other surfaces which will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Provide member installation tolerances more stringent than required by AISC where specifically required by the Contract Drawings and Specifications and where required at interfaces with adjoining materials as required to achieve the indicted details of construction.
1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Level and plumb individual members of structure within specified AISC tolerances.

3. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
4. Splice members only where indicated and accepted on shop drawings.

E. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

F. Bolted Connections: Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

G. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Architect. Finish gas-cut sections, when permitted, equal to a sheared appearance.

H. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas.
1. Apply paint to exposed areas of shop primed items, using same material as used for shop painting, by brush or spray to provide a minimum dry film thickness of 1.5 mils.
2. Field welded or damaged galvanized surfaces shall be repaired with product specified herein.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors, shaped as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.
1. Installation of Shear Connectors: Shear studs shall be automatically end welded in accordance with Article 31 of the AWS Structural Welding Code and the specifications of the shear stud manufacturer. After installation, each ceramic ferrule shall be removed prior to placement of concrete. Adequate welding power must be available for studs being welded.
2. All areas to which studs are to be attached shall be cleaned of all rust, oil, grease, and paint. When the mill scale is sufficiently thick to cause difficulty in obtaining proper welds, it shall be removed by grinding or sand blasting.

3.2 QUALITY CONTROL

A. The independent testing and inspection agency shall inspect high-strength bolted and welded connections, perform tests, and submit test reports.
1. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations there from.
2. Architect reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

B. Contractor's Responsibilities: Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any noncompliance of original work, and as may be necessary to show compliance of corrected work.

C. Shop Bolted Connections: Inspect in accordance with AISC specifications. Verify that gaps of installed Direct Tension Indicators are less than gaps specified in ASTM F 959, Table 2.

D. Shop Welding: Plant Inspector shall inspect and test during fabrication of structural steel assemblies, as follows:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.

2. Perform visual inspections of all welds.

3. Perform tests on all full-penetration welds as follows: Inspection procedures listed are to be used at Laboratory's option.
   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 109; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.
   c. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T".
   d. Ultrasonic Inspection: ASTM E 164.

E. Field Bolted Connections: Testing Laboratory shall inspect in accordance with AISC Specifications. Verify that gaps of installed Direct Tension Indicators are less than gaps specified in ASTM F 959, Table 2.

F. Field Welding: Testing Laboratory shall inspect and test during erection of structural steel as follows:
   1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   2. Perform visual inspection of all welds.
   3. Perform tests on all full-penetration welds and other welds as required by AISC, as follows:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 109; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.
      c. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
      d. Ultrasonic Inspection: ASTM E 164.

G. Shear Studs: Testing Laboratory shall inspect and test during erection as follows:
   1. Perform visual inspection of all welds.
   2. Verify stud quantity, diameter, length, and spacing.
   3. Perform bend test at six random studs per floor.
   4. Rubber mallet tap each stud.

END OF SECTION 05 12 00

SECTION 05 21 00 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 00 & 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Open-web DLH-series steel roof joists.
2. Joist accessories.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel".
2. Division 9 Section "Painting".
3. Division 5 section “Steel Deck”.

1.3 DEFINITIONS

A. Special Joists: Joists requiring modification by the manufacturer to support non-uniform, unequal, or special loading conditions that invalidate SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads within limits and under conditions indicated. Refer to drawings for specific loading information.

B. Wind Loads: Refer to drawings for components & cladding design pressures, including uplift pressures, and wind design parameters.

C. Design joists to withstand design loads with total load deflections no greater than the following:

1. Vertical deflection of 1/360 of the span.

1.5 SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings: Show layout, mark, number, type, location, and spacing of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
1. Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.
2. Comprehensive engineering analysis sealed by the qualified Louisiana licensed professional engineer responsible for its preparation.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.

1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
3. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in jurisdiction where the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of joists that are similar to those indicated for this Project in material, design, and extent.

B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates and other devices to be built into concrete and masonry construction.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

B. Steel Bearing Plates: ASTM A 36.

C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

D. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

E. Welding Electrodes: Comply with AWS standards.

2.2 PRIMERS

A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red oxide primers, OSHA compliant.

B. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements in FS TT- P-664, OSHA compliant.

2.3 OPEN-WEB DLH-SERIES STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, DLH-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; (unless otherwise indicated), of joist type indicated.

1. Joist Type: DLH-series steel joists.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

F. Camber joists according to SJI's "Specifications."

G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."

C. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface, unless otherwise indicated.

D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories to be primed by power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories [to receive sprayed fire-resistive materials].

C. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick. Verify primer compatibility with Division 9 painting requirements.

D. Painting of joists and joist accessories is specified in Division 9 Section "Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.

E. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. A qualified independent testing and inspecting agency shall inspect field welds and high-strength bolted connections.

B. All field welds will be visually inspected according to AWS D1.1. Verify welder AWS certifications.

C. Bolted connections will be visually inspected.

1. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

D. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.

E. Additional testing will be performed to determine compliance of corrected work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories and abutting structural steel.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.

2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 Section "Painting."

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 31 00 - STEEL DECKING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Divisions 00 & 01 Specifications apply to this Section.

1.2 SUMMARY

A. Section Includes: Steel deck units for floor and roof applications.

B. Related Sections:
1. Division 01 Section – “Submittal Procedures”.
2. Testing Laboratory Services.
3. Section 033000 – Cast-in-Place Concrete.
4. Section 051200 - Structural Steel Framing.
5. Section 052100 – Steel Joists

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of decking, accessories, and galvanizing repair product.

B. Shop Drawings: Hard copies are required. Submit shop drawings showing layout and types of deck units, anchorage details, and conditions requiring closure strips, supplementary framing, cant strips, cut openings, special jointing and other accessories.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with the following codes and standards, except as otherwise indicated:
1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members".
2. American Welding Society (AWS), D1.3 "Structural Welding Code - Sheet Steel".
3. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks".

B. Qualification of Field Welding: Use qualified welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS.

C. Underwriters' Label: Provide metal floor deck units listed in Underwriters' Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific system detailed.

D. FM Listing: Provide metal roof deck units that have been evaluated by Factory Mutual System and are listed in "Factory Mutual Approval Guide" for "Class I" fire-rated construction.

E. Testing: Refer to “Testing Laboratory Services”.

1.5 JOB CONDITIONS

A. Coordination: Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading structural members.

B. Safety: Do not use deck for storage or working platforms until units are permanently secured. Do not permit storage and operations on installed deck which could damage or deform the deck units.

C. Deck Insulation: Coordinate and cooperate with roof insulation installer to provide deck satisfactory for application of insulation. Provide manufacturer's insulation inserts at acoustical deck.

D. Ceiling Hangers: Coordinate and cooperate with ceiling installers for placing hangers.

PART 2 – PRODUCTS

2.1 STEEL DECK

A. Description: Dimensions and properties of steel deck are shown on the Drawings. Deck configuration shall be similar to that indicated. Allowable stress shall equal or exceed that of the deck specified on the Drawings.

B. Deck Type:
1. Deck sizes and types are indicated on the Drawings. Manufacturers noted are Basis-of-Design products. Pre-bid approval is required for substitutions.

C. Provide shop primer paint at deck scheduled to be painted. Coordinate with Division 9 requirements.

2.2 MATERIALS

A. Steel for Galvanized Metal Deck Units: ASTM A653, Grade as required to comply with SDI Specifications.

B. Miscellaneous Steel Shapes: ASTM A 36.

C. Galvanizing: ASTM A 924, G90.

D. Galvanizing Repair Compound: High zinc dust content paint for repairing damage and re-galvanizing welds, with dry film containing not less than 94% zinc by weight and complying with ASTM A 780.

E. Flexible Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

2.3 FABRICATION

A. General: Form deck units in lengths to span three or more supports, with flush, telescoped or nested 2-inch laps at ends and interlocking or nested side laps, of metal thickness, depth, and width as indicated.

B. Deck Units: Provide deck configurations that comply with SDI "Specifications and Commentary for Steel Roof Deck".

C. Metal Cover Plates: Fabricate metal cover plates for end-abutting floor deck units of not less than same thickness as decking. Form to match contour of deck units and approximately 6 inches wide.

D. Metal Closure Strips: Fabricate metal closure strips, for cell raceways and openings between decking and other construction, of not less than 0.045-inch min. (18 gage) sheet steel. Form to provide tight-fitting closures at open ends of cells or flutes and sides of decking.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install deck units and accessories in accordance with manufacturer's recommendations, shop drawings, and as specified herein.
   1. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
   2. Align deck units for entire length of run of cells and with close alignment between cells at ends of abutting units.
   3. Place deck units flat and square, secured to adjacent framing without warp or deflection.
   4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.

B. Attachment:

   1. Fasten deck units to steel supporting members and to adjacent deck units as indicated on Drawings.
   2. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. Use welding washers where recommended by deck manufacturer.

C. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.

D. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work shown.

E. Hanger Slots or Clips: Provide UL-approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.
   1. Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
   2. Locate slots or clips at not more than 14 inches o.c. in both directions, not over 9 inches from walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.
   3. Provide manufacturer's standard hanger attachment devices.

F. Joint Covers: Provide metal joint covers at abutting ends and changes in direction of floor deck units.

G. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.

1. Provide flexible closure strips instead of metal closures, at Contractor's option, wherever their use will ensure complete closure. Install with adhesive in accordance with manufacturer's instructions.
2. Provide a minimum of ¼" steel bent plate at all floor and roof penetrations.

H. Touch-Up Painting: After decking installation, wire brush, clean and paint scarred areas, welds, and rust spots on top and bottom surfaces of decking units and supporting steel members.
1. Touch-up galvanized surfaces with galvanizing repair paint in accordance with ASTM A 780.

3.2 TESTING LABORATORY SERVICES

A. The independent testing laboratory shall visually inspect all deck attachments to structure and sidelap deck attachment.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing wall framing and soffits.

B. Related Sections include the following:
   1. Division 06 Section 06 10 00 “Rough Carpentry” for treated blocking and plywood sheathing
   2. Division 09 Section 09 22 16 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated.
      a. Dead Loads: Weights of materials and construction
      b. Live Loads: Refer to Structural Drawings
      c. Snow Loads Refer to Structural Drawings
      d. Wind Loads: Refer to Structural Drawings
      e. Seismic Loads: Refer to Structural Drawings
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Per Brick Institute recommendations Exterior Non-Load-Bearing Framing: Horizontal deflection of the wall height at brick veneer or 0.3 inches, whichever is smaller. Horizontal/vertical deflection of L/360 at metal panels with ½” maximum limit.
      b. Ceiling, Rafter and Soffit Framing: Vertical deflection of L/360 at metals panels with ½” maximum limit
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of 1 inch

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacing, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Research/Evaluation Reports: For cold-formed metal framing.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed cold-formed metal framing similar in material, design and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
   2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

C. Store materials protected from exposure to rain, snow or other harmful weather conditions, at temperature and humidity conditions per the recommendations of ASTM C955

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
   1. Allied Studco.
   2. AllSteel Products, Inc.
   3. California Expanded Metal Products Company.
   4. Clark Steel Framing.
   5. Consolidated Fabricators Corp.; Building Products Division.
   6. Craco Metals Manufacturing, LLC.
   7. Custom Stud, Inc.
   8. Dale/Incor.
   9. Design Shapes in Steel.
   10. Dietrich Metal Framing; a Worthington Industries Company.
   11. Formetal Co. Inc. (The).
   12. Innovative Steel Systems.
   13. MarinoWare; a division of Ware Industries.
   14. Quail Run Building Materials, Inc.
   15. SCAFCO Corporation.
   16. Southeastern Stud & Components, Inc.
   17. Steel Construction Systems.
   18. Steeler, Inc.
   19. Super Stud Building Products, Inc.
   20. United Metal Products, Inc

2.2 MATERIALS – **All steel to be Galvanized G90.**

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING – **All Steel to be Galvanized G90.**

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 18 gauge. Provide 16 ga min. at brick veneer.
   2. Minimum Flange Width: 1-5/8 inches

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 16 gauge
   2. Minimum Flange Width: 1-1/4 inches

C. Vertical Deflection Clips: Manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.4 FRAMING ACCESSORIES

A. Fabricate **galvanized G90** steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.
   8. Stud kickers, knee braces, and girts.
   9. Joist hangers and end closures.
   10. Hole reinforcing plates.
   11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint ASTM A 780.

B. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members. Reference spec section Joint Sealants 07 92 00.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
   4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section 07 21 00, "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
1. Stud Spacing: 16 inches maximum

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install single-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and

thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 45 00 - METAL SUPPORT ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Above ceiling supports for overhead mounted medical equipment.

B. Slotted channel framing fabrications.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications

1.3 REFERENCE STANDARDS

A. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

B. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality; 1990b (Reapproved 2012).

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

1.4 SUBMITTALS

A. See Section 01 30 00 - for submittal procedures.

B. Product Data:

C. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
   2. Include erection drawings, elevations and details where applicable.
   3. Provide design engineer's stamp on shop drawings.

D. Design Data: Provide calculations for loadings and stresses of specially fabricated framing, stamped by a Professional Structural Engineer.

E. Manufacturer's Instructions: Indicate special procedures, conditions requiring special attention.

1.5 QUALITY ASSURANCE

A. Perform design under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Unistrut Corp.: www.unistrut.com.

B. B-Line Systems: www.cooperbline.com.

C. Power-Strut: www.power-strut.com.

D. GS Metals Corp.: www.gsmetals.com.

E. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PERFORMANCE CRITERIA

A. Loading: Design the support structure to support the maximum concentrated load that will be encountered by positioning the equipment at the extremities of its travel at any single point along the exposed rails.

B. Safety Factor: System designed with a minimum safety factor of 3 based upon ultimate strength under static loading conditions.

2.3 MATERIALS

A. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.
   1. Size of Channels: 1-5/8 by 1-5/8 inches.
   2. Material: Steel complying with ASTM A653/A653M, structural steel, Grade 33.
   3. Finish: ASTM A653/A653M, G90 coating..
   4. Manufacturer: Unistrut Corp., P1000 and P1001 series.

B. Perforated Tubing: Hot-roll formed square tubular steel with perforated holes on 1 inch centers each face.Tubing capable of telescoping; smaller sizes fitting into next larger size.
   1. Size, Gauge: As selected to meeting loading criteria.
   2. Material: Steel complying with ASTM A1011/A1011M, structural steel, Grade 50.
   3. Finish: ASTM A653/A653M, G90 coating.
   4. Manufacturer: Unistrut Corp., Telespar

2.4 COMPONENTS

A. Fittings, connectors and accessories: ASTM A653/A653M, structural steel, Grade 33.

B. Sintered nuts: ASTM A576, GR1015.

C. Closure strips: Snap-on extruded plastic, 0.085 inch thick; white. Unistrut P3184P.

2.5 FABRICATION

A. Verify dimensions on site prior to shop fabrication.

B. Fit and shop assemble in largest practical sections for delivery to site.

C. Supply components required for anchorage of metal framing. Fabricate anchorage and related components of same material and finish as metal fabrications, except where specifically noted otherwise.

PART 3 EXECUTION

3.1 PREPARATION

A. Make provision for erection loads with temporary bracing. Keep Work in alignment.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate Sections.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install items plumb and level, accurately fitted, free from distortion or defects.

C. Install closure strips at exposed channels in ceiling installations.

3.3 ERECTION TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Offset From True Alignment: 1/4 inch.

3.4 SCHEDULES

A. Provide items listed in Schedule or indicated on Drawings with anchorage and attachments necessary for installation.

B. The Schedule is a list of principal items only. Refer to Drawings for items not specifically scheduled.
   1. Ceiling supports for overhead mounted equipment.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel items.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.

C. Section 05 45 00 - Metal Support Assemblies: Slotted channel framing.

D. Section 05 51 00 - Metal Stairs.

E. Section 05 52 13 - Pipe and Tube Railings.

1.3 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.

B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.

F. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.

G. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.

H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.

K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2015.

L. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2013a.

M. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2009 (Reapproved 2015).

N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

Q. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months

D. Samples for Verification: For each type and finish of extruded nosing.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

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D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations for ceiling hung equipment supports.

1.5 QUALITY ASSURANCE

A. Design ceiling hung equipment supports under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Delegated Design: Design ladders and pipe grids, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   1. Pipe Grid Design Loads: 200 lbs per linear foot.

B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints,

overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Seismic Loading: Design and install ceiling hung equipment supports for static and for seismic conditions in accordance with regulatory requirements and the following:
   1. Comply with seismic loading requirements of the 2012 International Building Code and ASCE 7; Use Group I, Design Category "C", Site Class "E".

2.2 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Fasteners: Match or be compatible with metals being fastened.

F. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, plain.

G. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
   1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633, Class Fe/Zn 5.
   2. Material for Anchors in Exterior Locations: Alloy Group 2 stainless-steel bolts complying with ASTM F593 and nuts complying with ASTM F594.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius. Architectural Grade welds AESS 4.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATED ITEMS

A. The following is a list of principal items only. Refer to Drawings for items not specifically listed.

B. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; Interior, prime paint finish. Exposed to Outside Atmosphere: Galvanized finish.
   1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
   2. Rungs: one inch diameter solid round bar spaced 12 inches on center.

3. Space rungs 7 inches from wall surface.

C. Steel angle bucks and supports for lead lined door frames, prime painted.

D. Metal bracing and supports for architectural woodwork; prime paint finish.

E. Above ceiling supports for ceiling hung equipment and special conditions; prime painted.

F. Above ceiling supports for folding panel partition tracks; prime finish.

G. Toilet Partition Suspension Members: Steel angle sections; prime paint finish.

H. Masonry partition bracing; prime painted.

2.5 MANUFACTURED ITEMS

A. Vertical Ladder (Parapet Return): Fixed.
1. Material: ASTM B221, 6061 Alloy, T6 temper, mill finish.
2. Height: Refer to drawings.
3. Parapet Return: Extend rails 42 inches above parapet. Provide rails on opposite side mounted to rear of parapet and extending 42 inches above parapet and below parapet to roof line.
4. Angle: 90 degrees to horizontal.
5. Width: 20-1/4 inch.
6. Rungs: 1-1/8 inch diameter serrated solid round bar spaced 12 inches on center.
7. Railing: 2-1/2 inch "C" channel, 1/8 minimum wall thickness..
8. Security Door: 0.188 inch thick aluminum with piano hinges and padlock hasp.
9. Climbing height 20-30 feet: Install flared cage with 7 vertical bars and hoops at 4'-0" centers.
10. Product: Model 563 manufactured by Alaco Ladder Co.: www.alacoladder.com.

B. Fixed Ships Ladder with Crossover: ASTM B221, 6005 Alloy, T5 temper, mill finish.
1. Model: Precision SL Series
2. Width, inch: 30.
3. Angle: 63 degrees to horizontal.
4. Handrail Diameter, inch: 1-1/4, Schedule 40.
5. Tread Width, inch: 5-3/16.
6. Crossover: Aluminum bar grating.
7. Height/Run: Refer to drawings.

2.6 FINISHES - STEEL

A. Prime paint steel items.
1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

2.7 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Expansion Anchors: Prior to installation, verify that the expansion anchor complies with the specified loading criteria for material, size, and length. During installation, verify 100 percent of the expansion anchors for the following:
   1. Drilled hole diameter is the same as the anchor diameter.
   2. Anchor is installed to the specified embedment depth.
   3. Verify the installation torque is in compliance with manufacturer's installation instructions.
   4. Anchor is installed in compliance with the manufacturer’s printed instructions.

B. If reinforcement steel, prestressing strands, or other embedded items are encountered in the concrete where the expansion anchor is to be located, notify the Architect and Engineer of such interference.

END OF SECTION

SECTION 05 51 00 - METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stairs with concrete treads.

B. Structural steel stair framing and supports.

C. Handrails and guards.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal anchors in concrete.

B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.

C. Section 05 50 00 - Metal Fabrications.

1.3 REFERENCE STANDARDS

A. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2014.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

K. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.

L. NFPA 101 - Life Safety Code; 2015.

M. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's stamp or seal on each sheet of shop drawings
   3. Precast concrete treads
   4. Grout.

C. Welders' Certificates.

D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.5 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.1 METAL STAIRS – GENERAL

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
      a. Comply with NFPA 101, Chapter 7 Means of Egress.
   2. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.

      a Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

      b Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

      c. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.

      d. Design and fabricate stair assembly to support uniform and concentrated loads designated on the Drawings with deflection of stringers or landing framing not to exceed 1/180 of span.
   3. Dimensions: As indicated on drawings.
   4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   6. Separate dissimilar metals using paint or permanent tape.

C. Metal Jointing and Finish Quality Levels:

1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
   a. Welded Joints: Exposed welds: Continuously welded and ground smooth and flush, **Architecturally Exposed Structural Steel (AESS 4.)**
   b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
   c. Exposed Edges and Corners: Eased to small uniform radius.
   d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish. Exposed welds: Continuously welded and ground smooth and flush, **Architecturally Exposed Structural Steel (AESS 4.)**

D. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

E. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 METAL STAIRS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Concrete Treads and Risers:

Metal pan with field-installed concrete fill.

1. Concrete Depth: 1-1/2 inches, minimum.
2. Tread Pan Material: Steel sheet.
3. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
4. Tack weld metal lath to inside bottom of tread and landing pans.
5. Pan Anchorage to Stringers: Continuously welded, from top, to be exposed to view from bottom.
6. Concrete Reinforcement: None.
7. Concrete Finish: Steel troweled.

Risers: Same material and thickness as tread pans.

1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
2. Nosing Depth: Not more than 1-1/2 inch overhang.
3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

Railings: Steel pipe railings.

Finish: Shop- or factory-prime painted.

D. Terrazzo Treads and Risers

Metal pan with terrazzo fill. Refer to drawings, plans, sections, details and spec section 096623 Epoxy Terrazzo..

1. Terrazzo Depth: 1-1/2 inches, minimum.
2. Tread Pan Material: Steel sheet.
3. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
4. Tack weld metal lath to inside bottom of tread and landing pans.
5. Pan Anchorage to Stringers: Continuously welded, from top, to be exposed to view from bottom.
6. Concrete Reinforcement: None.

Risers: Same material and thickness as tread pans. Refer to stair details.

Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

Railings: SS railings, Refer to drawings

2.3 STEEL HANDRAILS AND GUARDS

A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
   1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.

B. Guards:
   1. Top Rails: Round pipe or tube rails unless otherwise indicated.
      a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
   2. Infill at Picket Railings: Vertical pickets.
      a. Horizontal Spacing: Maximum 4 inches on center.
      b. Shape: Round.
      c. Size: 1/2 inch diameter.
      d. Top Mounting: Welded to underside of top rail.
      e. Bottom Mounting: Welded to top surface of stringer.
   3. End and Intermediate Posts: Same material and size as top rails.
      a. Horizontal Spacing: As indicated on drawings.
      b. Mounting: Welded to top surface of stringer.

2.4 MATERIALS

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.

C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.

D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.

E. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).

F. Concrete Fill: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.

2.5 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
   2. Number of Coats: One.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).

F. Concrete Fill: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.

2.5 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.
1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
2. Number of Coats: One.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.

B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

E. Obtain approval prior to site cutting or creating adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

G. Stair Nosings: At steel pan stairs, provide continuous nosings less 1/8 inch clearance from ends of treads.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.

B. Related Sections:

1. Division 05 Section 05 51 00 "Metal Stairs" for steel tube railings associated with metal stairs.
2. Division 05 Section 05 73 13 "Decorative Metal Railings" for ornamental railings fabricated from pipes, mesh, and tubes.
3. Division 05 Section 05 50 00 "Metal Fabrication" for metal blocking for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 100lbs/ft. in any direction.
b. Concentrated load of 400lbs/ft. any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 100 lbs. applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 def F, ambient; 180 deg F, material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other

materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, and anchoring cement.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member.
2. Fittings and brackets.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Paint Compatibility Certificates: Refer to Division 09 painting Sections.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel and Architectural AESS 4 standards.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible

with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Pipe and Tube Railings:

a. Pisor Industries, Inc.
b. Wagner, R & B, Inc.; a division of the Wagner Companies.
c. Approved Equal.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is as follows:

1. Structural sections (W-Shapes, channels, angles, etc), decking and plate: Not less than 75 percent.
2. Hollow tubes and all other steel material: Not less than 25 percent.

B. Tubing: ASTM A 500 (cold formed).

C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or , Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide welded connections for interconnecting railing components and concealed fasteners for attaching them to other work, unless otherwise indicated to Architectural AESS 4 standards.
2. Provide tamper-resistant flat-head machine screws for instances where exposed fasteners are indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or , Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group stainless-steel bolts, , and nuts, .

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Division 09 painting Sections.

E. Intermediate Coats and Topcoats: Provide products that comply with Division 09 painting Sections.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately .09375 inches unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

I. Form changes in direction as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.

J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide steel sleeves not less than long with inside dimensions not less than greater than outside dimensions of post, with metal plate forming bottom closure.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Division 09 Section "Interior Painting" for back-of-house functions, and “High Performance Coatings” for exterior applications.

1. Colors: As selected by Architect from manufacturer's full range, allowing for the possibility of several color choices within each category.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location,

alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of. 1/8"
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed ¼ inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within of post.

3.3 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.4 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and connected to railing ends using nonwelded connections.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using nonwelded connections.

C. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 05 73 13 - GLAZED DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tempered Laminated glass railings at balconies and glass railings at Stair #2

1.2 RELATED REQUIREMENTS

A. Section 08 80 00 - Glazing: Glass used for other purposes.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.

E. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

1.4 PERFORMANCE REQUIREMENTS , PRODUCTS AND MANUFACTURERS

A. Delegated Design: Design the entirety of railing assemblies, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

    a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

    a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    b. Infill load and other loads need not be assumed to act concurrently.

3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

C.. Manufacturers

1.Basis of Design : C.R. Laurence Co., Inc.: www.crlaurence.com.

2.Blumcraft of Pittsburgh: www.blumcraft.com.

3.Or approved equal.

D. Structural Glass Railing Systems

1. Minimum specs for Base Shoe Type HG-7GS for 13/16" glass heavy structural aluminum base with Stainless steel cladding is a pre-engineered structural component minimum yield for 42" tall railing

2. Minumum specs for Top cap 2" diameter for 13/16" glass stainless steel minimum 18 gauge with u-channel insert for attachment. Part #HG-200RTC

3. Minimum specs for stainless steel cladding 18 ga. 304 grade #4 lineal finish

4. Minimum specs for glass; 13/16" ultra clear, low iron, laminated and tempered with make-up of 3/8" clear tempered laminated with .060 interlayer on 3/8" clear tempered. Minimum interlayer to be .060 PVB for interior and SGP for exterior applications

5. On site mock-up required for Architect's approval

1.5 SUBMITTALS

A. Summary: Section Includes:

1. Glass infill with railings at balcony and Stair #2.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **professional engineer** and **testing agency**

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

C. Preconstruction test reports.

D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: [**Owner will engage**] [**Engage**] a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made [**by Owner**] [**from the testing and inspecting allowance, as authorized by Change Orders**] [**by Contractor**]. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings according to ASTM E894 and ASTM E935.

B. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
1. Provide details and calculations for railing system, stamped by a Professional Structural Engineer.

D. Design Data: Provide member structural and physical characteristics and engineering calculations, and identify dimensional limitations as prepared, sealed and signed by a structural engineer licensed in the State in which the Project is located.

E. Selection Samples: For each metal finish specified, two complete sets of finish samples, 3 x 5 inches.

F. Test Reports: Submit test reports indicating compliance with ASTM E985.

G. Maintenance Instructions: Submit manufacturer’s maintenance and cleaning instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
   1. All metal fabrication performed by a single source fabricator.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience.

C. Perform design and prepare shop drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

A. Design, and fabricate railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code. Test in accordance with ASTM E935.

B. Safety Glazing Products: Comply with 16 CFR 1201 and ANSI Z97.1 requirements.

C. Allow for expansion and contraction of members and building movement without damage to connections or members.

D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

E. Manufacturer all mechanical fasteners used in assembly of stainless steel railings stainless steel.

2.2 FABRICATION

A. Orient pattern and draw of glass pieces in same direction. Place waves in sheet glass parallel to floor.

B. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[**, but not less than that required to support structural loads**].

C. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints

D. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[, but not less than that required to support structural loads].

E. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

F. Form changes in direction [by bending] [or] [by inserting prefabricated elbow fittings].

G. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

H. Close exposed ends of hollow railing members with prefabricated end fittings.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and as indicated on drawings.

B. Fit exposed connections accurately together to form tight joints except as necessary for expansion.

C. Perform cutting, drilling, and fitting required for installation of handrails. Accurately set handrails in location, alignment, and elevation, measured from established lines and levels.

D. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

1. For anchorage to concrete, provide inserts to be cast into concrete, for welding anchors.

F. Structural Glass Railings: Anchor to substrate in strict accordance with tested anchorage system.

G. Remove protective film promptly so that it does not set.

H. Clean glass and metal surfaces.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION

06

WOOD, PLASTICS AND COMPOSITES

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Wood blocking, cants, and nailers.
   2. Interior and exterior wood sheathing panels.

1.3 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings

1.6 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

B. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with firetest-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following
   1. Concealed blocking.
   2. Plywood equipment backing panels

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

D. Provide fire blocking in concealed cavities as indicated.

E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 10 53 - MISCELLANEOUS CARPENTRY

PART 1 – GENERAL (NOT APPLICABLE)

PART 2 - PRODUCTS

A. Lumber, General: Comply with PS 20 and with applicable grading rules; factory-mark with grade, species, moisture content at time of surfacing, and mill; dressed lumber, S4S, unless otherwise indicated.

B. Concealed Dimension Lumber: As follows:

1. Species: Any wood species listed by PS 20.
2. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
3. Grade: No. 2 or standard grade.

C. Exposed Dimension Lumber: As follows:

1. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
2. Grade: No. 1 or construction grade.

D. Concealed Boards: As follows:

1. Species: Any wood species listed by PS 20.
2. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
3. Grade: No. 2, 2 Common, or Construction Boards.

E. Exposed Boards: As follows:

1. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
2. Grade: No. 1, 1 Common, Construction Heart, or Select Merchantable Boards.

F. Miscellaneous Concealed Plywood: PS 1, C-C Plugged Exterior, thickness as indicated but not less than 1/2 inch nominal.

G. Electrical/Telephone Backing Panels: APA-RATED SHEATHING, Exposure 1, fire-retardant treated, thickness as indicated but not less than 15/32 inch.

H. Preservative Treatment: Obtain preservative-treated lumber complying with AWPA Standard C2. Mark each treated item with AWPB or SPIB Quality Mark Requirements. Coat surfaces cut after treatment to comply with AWPA M4.

1. Above-Ground Wood Treatment: Pressure treat with waterborne preservatives to a minimum retention of 0.25 pcf. Treat wood items indicated and in contact with roofing, flashing, waterproofing, masonry, concrete, and within 18 inches of grade. Kiln-dry interior dimension lumber and construction panels after treatment to 19 and 15 percent maximum moisture content, respectively.

PART 3 - EXECUTION

A. Cut and fit miscellaneous carpentry accurately and securely fasten. Install members plumb and true to line and level.

B. Countersink nail and bolt heads on exposed carpentry work and fill holes.

C. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work.

END OF SECTION 06 10 53

SECTION 06 36 61.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes plastic-laminate-clad countertops.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.

C. Samples for Verification: As follows:

1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches (200 by 250 mm) in size.
2. Wood-Grain Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches (200 by 250 mm) in size.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For the following:

1. Composite wood and fiber products.
2. High-pressure decorative laminate.
3. Chemical-resistant, high-pressure decorative laminate.
4. Adhesives.

B. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Premium

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by manufacturer's designations.
2. Match Architect's sample.
3. As selected by Architect from manufacturer's full range in the following categories:

a. Solid colors, matte finish.
b. Solid colors with core same color as surface, gloss finish.
c. Wood grains, matte finish with grain running parallel to length of countertop.

E. Edge Treatment: 3-mm (0.12 inch) PVC edging

F. Core Material: Fire-retardant-treated plywood

G. Core Material at Sinks: Exterior-grade plywood

H. Core Thickness: 3/4 inch (19 mm)

1. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of core material laminated to top.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is

extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained or natural transparent finish, use organic resin chemical formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of exposed treated woodwork.

C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less when tested according to ASTM E84.
   1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.

D. Fire-Retardant MDF: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less according to ASTM E84.

2.4 ACCESSORIES

A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.

2.5 MISCELLANEOUS MATERIALS

A. Adhesive

   1. Adhesive for Bonding Edges: Hot-melt adhesive

   2. Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times countertop fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.
2. Secure backsplashes
3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semi-exposed surfaces.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 06 36 61.13

SECTION 06 36 61.16 - SOLID SURFACE FABRICATIONS

PART 1 — GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following horizontal and trim solid surface product types:

1. Countertops with sinks
2. Reception areas/nurses stations
3. Backsplashes

B. Related Sections include the following:

1. Division 6 Section 06 10 00 "Rough Carpentry" for Blocking.
2. Division 22 Section "Plumbing Fixtures."
3. Division 26 Section "Wiring Devices."

1.3 DEFINITION

A. Solid surface is defined as nonporous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

1.4 SUBMITTALS

A. Product data:

1. For each type of product indicated.

B. Shop drawings:

1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components.
    a. Show full-size details, edge details, thermoforming requirements, attachments, etc.
    b. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
    c. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacle and other items installed in solid surface.

C. Samples:

1. For each type of product indicated.
    a. Submit minimum 6-inch by 6-inch sample in specified gloss.
    b. Cut sample and seam together for representation of inconspicuous seam.
    c. Indicate full range of color and pattern variation.
2. Approved samples will be retained as a standard for work.

D. Product data:

1. Indicate product description, fabrication information and compliance with specified performance requirements.

E. LEED Data: NOT USED

F. Product certificates:
1. For each type of product, signed by product manufacturer.

G. Fabricator/installer qualifications:
1. Provide copy of certification number.

H. Manufacturer certificates:
1. Signed by manufacturers certifying that they comply with requirements.

J. Maintenance data:
1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions.
a. Maintenance kit for finishes shall be submitted.
2. Include in project closeout documents.

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.

B. Fabricator/installer qualifications:
1. Work of this section shall be by a certified fabricator/installer, certified in writing by the manufacturer.

C. Applicable standards:
1. Standards of the following, as referenced herein:
a. American National Standards Institute (ANSI)
b. American Society for Testing and Materials (ASTM)
c. National Electrical Manufacturers Association (NEMA)
d. NSF International
2. Fire test response characteristics:
a. Provide with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
1) Flame Spread Index: 25 or less.
2) Smoke Developed Index: 450 or less.

D. Coordination drawings:
1. Shall be prepared indicating:
a. Plumbing work.
b. Electrical work.
c. Miscellaneous steel for the general work.
d. Indicate location of all walls (rated and non-rated), blocking locations and recessed wall items, etc.
2. Content:
a. Project-specific information, drawn accurately to scale.
b. Do not base coordination drawings on reproductions of the contract documents or standard printed data.
c. Indicate dimensions shown on the contract drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements.

d. Provide alternate sketches to designer for resolution of such conflicts.
1) Minor dimension changes and difficult installations will not be considered changes to the contract.

E. Drawings shall:
1. Be produced in 1/2-inch scale for all fabricated items.

F. Drawings must be complete and submitted to the architect within 60 days after award of contract for record only.
1. Not Used
2. Coordination drawings are required for the benefit of contractor's fabricators/installers as an aid to coordination of their work so as to eliminate or reduce conflicts that may arise during the installation of their work.

G. Pre-installation conference:
1. Conduct conference at project site to comply with requirements in Division 1.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver no components to project site until areas are ready for installation.
B. Store components indoors prior to installation.
C. Handle materials to prevent damage to finished surfaces.
1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

A. Provide manufacturer's warranty against defects in materials.
1. Warranty shall provide material and labor to repair or replace defective materials.
2. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.

1.8 MAINTENANCE

A. Provide maintenance requirements as specified by the manufacturer.

PART 2 — PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Subject to compliance with requirements, provide products by one of the following:
a. Wilsonart® Solid Surface (basis of design).
b. Approved equal
2. See Finish Standards on drawing sheets for color selections.

2.2 MATERIALS

A. Solid polymer components
1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.

B. Thickness:
1. 1/2 inch

C. Performance characteristics:

Properties	Typical Results	Test
Tensile Strength	6800 psi*	ASTM D 638
Tensile Modulus	1.5 x106 psi	ASTM D 638
Tensile Elongation	0.4% min.	ASTM D 638
Flexural Strength	10,400 psi*	ASTM D 790
Flexural Modulus	1.73 x106 psi	ASTM D 790
Thermal Expansion Coefficient	1.37 x10-5 in./in./°F	ASTM D 696
Hardness (Barcol Impressor)	60	ASTM D 2583
Impact Resistance	144 in. drop[A]	ISO 4586
Izod Impact	0.28 (ft-lb.)/in	ASTM D 256
Method A Light Resistance - Xenon	No effect	ISO 4586
Stain Resistance	Pass	ANSI Z-124.3 modified
Wear and Cleanability	Pass	ANSI Z-124.3
Fungi Resistance	Pass	ASTM G 21
Bacterial Resistance	Pass	ASTM G 22
Boiling Water Resistance	No effect	ISO 4586
High Temperature Resistance	No effect[B]	ISO 4586
Weatherability	ΔE>5	ASTM G 155
Moisture Absorption	<.025%	ASTM D 570 Long Term
Specific Gravity	1.7 gram/cm^3	ASTM D 792
Approximate Weight	4.4 lb./ft^2	
Fire Behavior	Class 1 and Class A	ASTM E 84

* test results vary slightly depending on pattern

[A] No fracture

[B] High temperature resistance tests may have an effect on the surface; however, the surface can be renewed to 'No Effect'.

2.3 ACCESSORIES

A. Joint adhesive:

1. Manufacturer's standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.

B. Sealant:

1. Manufacturer's standard mildew-resistant, FDA-compliant, NSF 51-compliant (food zone — any type), UL-listed silicone sealant in colors matching components.

C. Sink/lavatory mounting hardware:

1. Manufacturer's standard bowl clips, panel inserts and fasteners for attachment of undermount sinks/lavatories.

D. Conductive tape:

1. Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat sources.

E. Insulating felt tape:

1. Manufacturer's standard for use with conductive tape in insulating solid surface material from adjacent heat source.

2.4 FACTORY FABRICATION

A. Shop assembly

1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.
2. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
    a. Reinforce with strip of solid polymer material, 2" wide.
3. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
4. Rout and finish component edges with clean, sharp returns.
    a. Rout cutouts, radii and contours to template.
    b. Smooth edges.
    c. Repair or reject defective and inaccurate work.

2.5 FINISHES

A. As selected from full range of samples

PART 3 — EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
    1. Provide product in the largest pieces available.
    2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
    a. Exposed joints/seams shall not be allowed.
    3. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
    4. Cut and finish component edges with clean, sharp returns.
    5. Rout radii and contours to template.
    6. Anchor securely to base cabinets or other supports.
    7. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
    8. Carefully dress joints smooth, remove surface scratches and clean entire surface.
    9. Install countertops with no more than 1/8-inch (3 mm) sag, bow or other variation from a straight line.
B. Backsplashes and applied sidesplashes:
    1. Provide coved backsplashes and sidesplashes at all walls and adjacent millwork.
    2. Install applied sidesplashes using manufacturer's standard color-matched silicone sealant.
    3. Adhere applied sidesplashes to countertops using manufacturer's standard color-matched silicone sealant.

3.3 REPAIR

A. Repair or replace damaged work which cannot be repaired to architect's satisfaction.

3.4 CLEANING AND PROTECTION

A. Keep components clean during installation.

B. Remove adhesives, sealants and other stains.

END OF SECTION 06650

SECTION 06 36 61 – SIMULATED STONE FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quartz surfacing fabrication.

1.02 RELATED REQUIREMENTS

A. Section 06 40 23 – Interior Architectural Woodwork: Shop-fabricated custom casework.

1.03 REFERENCE STANDARDS

A. ASTM C 97 – Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone; 2009.

B. AWI (QCP) – Architectural Woodwork Standards (Quality Certification Program), www.awiqcp.org; current edition at www.awiqcp.org.

C. AWMAC (GIS) – Architectural Woodwork Manufacturers Association of Canada (Guarantee and Inspection Services Program); current edition at www.awmac.com/gis.php.

D. AWS (AWI/AWMAC/WI) - Architectural Woodwork Standards (Architectural Woodwork Institute / Architectural Woodwork Manufacturers Association of Canada / Woodwork Institute) (www.awinet.org - www.awmac.com - www.woodworkinstitute.com); Edition 1, 2009.

E. MIA-DSDM – Marble Institute of America, Dimension Stone Design Manual; 2005.

F. WI (CCP) – Woodwork Institute (Certified Compliance Program); current edition at www.woodworkinstitute.com/certification.

G. WI (MCP) – Woodwork Institute (Monitored Compliance Program); current edition at www.woodworkinstitute.com/certification.

1.04 SUBMITTALS

A. Comply with Section 01 33 00 Submittal Procedures for administrative and procedural requirements for processing of submittals during the construction phase.

B. Product Data: Provide data on material characteristics, performance criteria and limitations, installation instructions, and cleaning and maintenance instructions.

C. Shop Drawings: Provide complete detailed and dimensioned drawings combined with shop drawings of cabinets and casework specified in other sections showing fabrication details, edging, sink installation, coving, seams, fastener types and locations, use and type of sealant, and fabrication details for support brackets.

D. Samples: Provide samples of colors as indicated on Drawings; submit 4 x 4 inch samples showing each color and finish.
   1. When colors are not indicated on Drawings, submit manufacturer's standard color book showing colors of actual material in greater than 1 1/2 inch (36mm) size.
   2. Upon selection of colors, submit samples as indicated above.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Certificates: Certify that products meet or exceed specified requirements.
   1. Low emitting VOC.
   2. Does not support growth of mold, mildew and bacteria on surface.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Prestige Stone Quartz Surfacing or approved equal.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling: Store materials in clean, dry, interior area in accordance with manufacturer's instructions. Protect materials from damage during handling and installation.

1.07 AMBIENT CONDITIONS

A. Maintain ambient temperature of 50 to 95 degrees F (10 to 35 degrees C) for 48 hours before, during and for minimum 7 days after installation.

1.08 WARRANTY

A. Manufacturer Warranty: Submit manufacturer's standard 10 year warranty.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Cambria Torquey, or approved equal

2.02 QUARTZ SURFACING COUNTERTOPS

A. Architect to choose from manufacturer's full line of products

B. Natural Quartz and Resin Composite Countertops: Non-porous blend of natural quartz, 93 percent, and polyester resin, 7 percent, formed into flat slabs over continuous substrate
   1. Overall Slab Size: 120 x 55 inches (3m x 1.4m).
   2. Flat Sheet Thickness: 25/32 inch (20mm
   3. Slab Weight:
      a. Slab – 25/32 Inch: 463 lbs (210 kg).
   4. Edge Detail: Flat Polish
      a. Surface Finish: Polished
      b. Color: Architect to choose from manufacturer's full line of products

C. Performance Criteria:
   1. ASTM C97; Moisture Absorption: typical results negligible.
   2. ASTM C99; Modulus of Rupture: typical results 6,800 psi.
   3. ASTM C170; Compressive Strength: typical results 24,750 psi.
   4. ASTM C501; Abrasion Resistance: typical results 223.
   5. ASTM C482; Bond Strength: typical results 205 psi.
   6. ASTM 484; Thermal Shock: Passes 5 cycles.
   7. ASTM C531; Coefficient of Thermal Expansion: typical results 1.2x10-5 inch/°F.
   8. ASTM C648; Breaking Strength of Tile: typical results 3,661 lbf.
   9. ASTM C1026; Resistance to Freeze-Thaw Cycling: Unaffected 15 cycles.
   10. ANSI A137.1; Wet Dynamic Coefficient of Friction [0.34 polish] / [0.47 matte].
   11. ANSI A137.1; Dry Dynamic Coefficient of Friction [0.72 polish] / [0.80 matte].
   12. ASTM E84; Surface Burning Characteristics: typical results 17 (Class A/1 Rating).
   13. ASTM E662; Smoke Density: Flaming 196, Non-flaming 69.
   14. ANSI Z124.6; Stain Resistance: Unaffected.
   15. ASTM 650-04; Chemical Resistance: Unaffected.

2.03 FABRICATION

A. Fabricate components to greatest extent practical in sizes and shapes as indicated and in accordance with MIA-DSDM.
   1. Inspect Quartz Surfacing prior to fabrication.

B. Fabricate joints between components using manufacturer's recommended, color matched, joint adhesive, reinforce as required.
   1. Maximum Joint Width: 1/32 inch (.75 mm)

C. Fabricate factory cutouts for plumbing fittings and bath accessories as indicated on the Drawings.

D. Fabricate and finish routed edges of component with clean, sharp returns.

E. Fabricate cutouts, radii and contours using template to ensure clean, sharp edges.

F. Fabricate backsplash height and profile as indicated on the Drawings.

G. Fabricate countertop components with finish as indicated.

H. Provide insulation between countertop material and adjacent hot water pans and food warmers.

I. Provide thermal isolation between hot and cold applications.

J. Provide venting of cabinets as required.

2.04 FABRICATION TOLERANCE

A. Panel Thickness Tolerance:
   1. Thickness of 3/8 to 1/2 Inch (9.5mm to 12.7mm): Plus or minus 1/32 inch (0.8mm).
   2. Thickness of 3/4 to 1 5/8 Inch (19mm to 41.3mm): Plus or minus 1/8 inch (3.2mm).
   3. Thickness Greater Than 1 5/8 Inch (41.3mm): Plus or minus 1/4 inch (6.4mm).

B. Panel Face Dimension: Plus or minus 1/16 inch (1.6mm).

C. Rectangular Face Variation (Maximum out of Square): Plus or minus 1/16 inch (1.6mm).

D. Heads and Calibrated Edges: Plus or minus 1/16 inch (1.6mm).

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that field conditions are acceptable and are ready to receive this work.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for installation of this work.

3.03 INSTALLATION

A. Install countertop materials in accordance with manufacturer's instructions.

B. Install components plumb and level and in accordance with approved shop drawings and installation details.
   1. Tops: Within 1/8 inch (3.2mm) of a flat surface over a 10 foot (0.3m) length.
      a. Install with at least 1/16 inch (1.6mm) to at most 1/8 inch (3.2 mm) clearance between surface perimeter and wall.

C. Install backsplashes and endsplashes as indicated on the Drawings.
   1. Adhere to countertops using appropriate adhesive and color matched silicone sealant.

D. Interface with Other Work: Provide proper installation of other materials and work as necessary for a complete and properly functioning system.

3.05 CLEANING

A. Remove adhesives, sealants and other stains from surfaces in accordance with manufacturer's instructions.

B. Clean countertops prior to date of Substantial Completion.

3.06 PROTECTION

A. Protect surfaces from damage during construction until date of Substantial Completion, replace damaged work.

END OF SECTION 12 36 61

SECTION 06 40 23- INTERIOR ARCHITECTURAL WOODWORK

(includes Plastic Laminate Cabinets)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Plastic-laminate cabinets.
   2. Shop finishing of interior woodwork.

B. Related Sections include the following:
   1. Division 06 Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
   2. Division 06 Section 06 36 61 “Simulated Stone Fabrications”
   3. Division 06 Sectin 06 36 61.13 “Plastic-Laminate-Clad Fabrications”
   4. Division 06 Section06 36 61.16 “Solid Surface Fabrications”

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets and other items installed in architectural woodwork

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in- service performance

B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for **Premium Grade** of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Products: Comply with the following:
1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
3. Particleboard: ANSI A208.1, Grade M-2.
4. Softwood Plywood: DOC PS 1.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

C. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

D. Provide PVC 3 mm edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges and as indicated on drawings sheets.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
      a. Wilsonart International; Div. of Premark International, Inc.
      b. Or approved equal

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Frameless Concealed Self-Closing Hinges (European Type): BHMA A156.9, B01602, 120 degrees of opening. Approved manufacturers: Blum, Grass, Mepla or Salcie.

C. Continuous Hinges: BHMA A156.26.

D. Wire Pulls: Back mounted, solid dull chrome, 4 inches long, 5/16 inch in diameter.

E. Catches: Push-in magnetic catches, BHMA A156.9, B03131.

F. Shelf Rests: 5 mil metal pin style; clear finish.

G. Door Locks: Magnetic touch latch unless otherwise indicated on drawings.

H. Coat Hooks for Lockers

I. Concealed Joint Fasteners: Threaded steel KV 516.

J. Drawer Slides: KV 8400 Accuride 3/4” extension types 3832 series.

   1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; 3/4 extension type; zinc-plated steel ball-bearing slides.
   2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide. 75 lb rated. Approved Manufacturer: Blum.

K. Grommets for Cable Passage through Countertops: 2-inch OD, color as selected by Architect, molded-plastic grommets and matching plastic caps with slot for wire passage. Field located per Owner.

L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

   1. Satin Stainless Steel.

M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

N. Concealed brackets by A & M C/EC Flat Concealed Brackets. Color to be selected by Architect.

2.3 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. In-wall Blocking: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

E. Use silicone-type for solid surface materials.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

D. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.

E. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

G. Seal edges of openings in countertops with a coat of varnish.

H. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

2.5 PLASTIC-LAMINATE CABINETS

A. AWI Type of Cabinet Construction: Flush overlay.

B. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS/GP-50.
2. Postformed Surfaces: Grade HGP/PF-42.
3. Vertical Surfaces: Grade VGS
4. Edges: 3 mm PVC matching laminate in color, pattern, and finish as manufactured by Canplast Inc. (800)-599-4455 or approved equal. Provide architect with full range of edge banding color selections for review and selection.

C. Materials for Semiexposed surfaces
1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
    a. Edges of Plastic-Laminate Shelves: 3mm PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish. Provide architect with full range of edge banding color selections for review and selection.
    b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade CLS.
2. Drawer Sides and Backs: Thermoset decorative panels.
3. Drawer Bottoms: Thermoset decorative panels.
4. Provide dust panels of 1/4-inch plywood or tempered hard board above compartments and drawers except where located directly under tops.

D. Shelving: Provide adjustable shelf multiple holes, min 5 mil with 5mil metal pin style; clear finish.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces scheduled in the Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for

fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 40 23

DIVISION

07

THERMAL AND MOISTURE PROTECTION

SECTION 07 13 00 - SHEET WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheet Waterproofing:
   1. Modified bitumen sheet membrane.

1.2 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation: Insulation used for protective cover.

B. Section 07 90 05 - Joint Sealers: Sealant for joints in substrates.

1.3 ABBREVIATIONS

1.4 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

C. ASTM D5957 - Standard Guide for Flood Testing Horizontal Waterproofing Installations; 1998 (Reapproved 2013).

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

E. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

1.5 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide data for membrane.

C. VOC Content: certification of data indicating VOC (Volatile Organic Compound) content of all components of waterproofing system.

D. Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section

B. Installer Qualifications: Company specializing in performing work of the type specified

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Grace Construction Products; Product Bituthene 3000; www.na.graceconstruction.com.

B. Other Acceptable Manufacturers:
   1. Henry Company; Product Blueskin WP200: www.henry.com.
   2. W.R. Meadows, Inc; Product Mel-Rol: www.wrmeadows.com.
   3. Carlisle Coatings & Waterproofing Incorporated; MiraDRI 860/861: www.carlisle-ccw.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MEMBRANE MATERIALS

A. Modified Bituminous Sheet Membrane: Asphalt and polymer modifiers of SBS type, reinforced with non-woven polyester; smooth surfaced.
   1. Formulated for seaming by contact adhesive.
   2. Thickness: 1/16 inch.
   3. Sheet Width: 36 inch, minimum.
   4. Tensile Strength: 325 psi, measured in accordance with ASTM D412.
   5. Ultimate Elongation: 300 percent, measured in accordance with ASTM D412.
   6. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, water immersion.
   7. Water Vapor Permeability: 0.05 perm inch, measured in accordance with ASTM E96/E96M.

B. Primer: Compatible with membrane; as recommended by membrane manufacturer.

C. Rubberized Mastic: Compatible with membrane; as recommended by membrane manufacturer.

D. Liquid Membrane: Compatible with membrane; as recommended by membrane manufacturer.

2.3 ACCESSORIES

A. Protection Board: 1/8 inch thick bitumen impregnated glass fiberboard .

B. Cant Strips: Premolded composition material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.

E. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

3.3 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.

D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

G. Coordinate with drain installation; see Division 22.

H. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

I. Seal membrane and flashings to adjoining surfaces.

3.4 INSTALLATION - DRAINAGE PANEL and PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.

B. Protection board not required when drainage matting or insulation board is applied over membrane material.

C. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.

D. Adhere protection board to substrate with compatible adhesive.

3.5 FIELD QUALITY CONTROL

A. On completion of horizontal membrane installation, dam installation area in preparation for flood testing in accordance with ASTM D5957.

B. Flood to minimum depth of 1 inch with clean water, and after 48 hours inspect for leaks.

C. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.

D. When area is proven watertight, drain water and remove dam.

3.6 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

3.7 SCHEDULE

A. Modified bituminous membrane, self-adhering.
   1. Elevator pit walls.
   2. Planter basin, vertical sides and bottom slab.
   3. Exterior side of pool walls
   4. Retaining walls.

END OF SECTION

SECTION 07 13 13 - UNDERSLAB VAPORPROOFING / WATERPROOFING MEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underslab vaporproofing/waterproofing membrane in horizontal applications.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-In-Place Concrete

B. Section 03 30 01 Under Slab Vapor Barrier

C. Section 07 13 00 - Sheet Waterproofing

D. Section 07 62 00 - Sheet Metal Flashing and Trim

1.3 REFERENCE STANDARDS

A. ASTM D5957 - Standard Guide for Flood Testing Horizontal Waterproofing Installations; 1998 (Reapproved 2013).

B. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

C. ASTM E1993/E1993M - Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs; 1998 (Reapproved 2013).

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

E. ASTM F1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor; 2006 (Reapproved 2011).

F. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.4 SUBMITTALS

A. See Section 01 33 00, for submittal procedures.

B. Product Data: Provide data for membrane and accessories.

C. Manufacturer's Installation Instructions: Indicate special procedures.

D. Certificate: Certify that products meet or exceed specified requirements.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA ML104 for waterproofing system.

B. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with three years experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide two year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. W.R. Meadows, Inc: www.wrmeadows.com.or approved equal.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MEMBRANE MATERIALS

A. Bituminous Vaporproofing / Waterproofing Membrane: ASTM E1993/E1993M, seven-ply, asphalt-coated, permanently bonded, semi-flexible bituminous core board composed of a 3-ply plasmatic matrix, sealed between liners of asphalt-impregnated felt and a glass mat liner and covered with a polyethylene anti-stick sheet.
   1. Weight: 1.60 lb/ sq ft.
   2. Width: 48 inch, minimum.
   3. Water Vapor Permeability: 0.0011 perms, minimum in accordance with ASTM F1249, calibrated to ASTM E96/E96M, Water Method.
   4. Tensile Strength: 156 lb force/inch, measured in accordance with ASTM E154/E154M, Section 9.
   5. Puncture Resistance: 149 lb. force in accordance with ASTM E154/E154M.
   6. Product: Premolded Membrane Vapor Seal with Plasmatic Core manufactured by W. R. Meadows.

2.3 ACCESSORIES

A. Bonding Asphalt: Catalytic Bonding Asphalt manufactured by W. R. Meadows.

B. Adhesive: Pointing Mastic manufactured by W. R. Meadows.

C. Joint Tape: PMPC Tape manufactured by W. R. Meadows.

D. Pointing Mastic: Pointing Mastic manufactured by W. R. Meadows.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of membrane system.

C. Verify that items that penetrate surfaces to receive membrane are securely installed.

3.2 PREPARATION

A. Prepare surfaces to receive membrane in accordance with manufacturer's instructions.

B. Do not apply membrane to surfaces unacceptable to membrane manufacturer.

3.3 INSTALLATION - MEMBRANE

A. Apply membrane in accordance with manufacturer's instructions to provide a permanent, monolithic vapor seal without voids or open seams.

B. Ensure accessory materials are compatible with membrane and approved by membrane manufacturer.

C. Place membrane in position by either Dutch lap method with laps sealed with bonding asphalt or by butt joint method with joints sealed with joint tape.

D. Point exposed edges with pointing mastic to prevent water from traveling under membrane.

E. Coordinate with drain installation; see Section 22 10 10 Plumbing Piping
Extend waterproofing material into drain clamp
flange; apply adequate coating of bonding asphalt to assure clamp ring seal.

F. In accordance with manufacturer's installation instructions, place membrane collar around penetrations through concrete slab, including pipes, conduits and utility devices to create a positive seal between penetrations and membrane. Seal in place with joint tape and point around penetrations with pointing mastic.

G. Adhere membrane to vertical surfaces with adhesive.

H. Install counterflashing over all exposed edges.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. On completion of horizontal membrane installation, dam installation area in preparation for flood testing in accordance with ASTM D5957.

C. Flood to minimum depth of 2 inch with clean water. After 48 hours, inspect for leaks.

D. If leaking is found, remove water, repair leaking areas with new membrane materials as directed by Architect; repeat flood test. Repair damage to building.

E. When area is proven watertight, drain water and remove dam.

F. Representatives of Contractor and membrane manufacturer shall be present for final inspection.

3.5 PROTECTION

A. Protect membrane from damage until placement of concrete.

3.6 SCHEDULE

A. Bituminous Vaporproofing / Waterproofing Membrane:
1. Install at grade supported slabs. Extend membrane 3 feet beyond perimeter of such areas. Seal membrane edges with adjacent below-grade sheet vapor retarders.
2. Install at grade supported slabs located below water table.
3. Horizontal underslab applications beneath cast-in place concrete

END OF SECTION

SECTION 07 16 14 - POLYMER MODIFIED CEMENT WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polymer modified cement waterproofing.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete to be waterproofed.

1.3 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.

B. ASTM C666/C666M - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing; 2015.

C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Details of joints and intersections.

C. Certification: Provide manufacturer's certification that waterproofing to be provided is suitable for the purpose specified and the locations where it is intended to be installed and that the requirements of the contract documents do not preclude satisfactory installation and performance.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging, marked with manufacturer's product identification.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Keep stored products dry; store under cover and elevated above grade.

1.7 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. See Section 01 77 00 Closeout Procedures or additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Polymer-Modified Cement Waterproofing:
   1. BASF Construction Chemicals-Building Systems MasterSeal 550: www.buildingsystems.basf.com.

2.2 MATERIALS

A. Polymer-Modified Cement Waterproofing : Manufactured slurry coating of Portland or hydraulic cement, aggregates, polymer admixtures, and water; no solvents; for application directly to cementitious substrate.
   1. Explicitly recommended by manufacturer as waterproofing, not simply as dampproofing.
   2. Requiring green concrete cure time of not more than 28 days.
   3. Elongation at Failure: 20 percent, minimum, when tested in accordance with ASTM D412.
   4. Water Vapor Transmission: MINIMUM permeance of finished coating of 1 perm, when tested in accordance with ASTM E96/E96M.
   5. Freeze-Thaw Durability: No change when tested in accordance with ASTM C666/C666M for 300 cycles.
   6. Compressive Strength: 5,000 psi, minimum, at 28 days, when tested in accordance with ASTM C109/C109M.
   7. Finished Coating Thickness: As recommended by manufacturer for the specific application but not less than 1/16 inch.

B. Crack Repair Material, Joint Tape, and Reinforcing: Type and application as recommended by waterproofing manufacturer.

C. Water: Clean, clear, non-alkaline potable water, free of salts and other harmful elements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces where waterproofing is to be applied for conditions detrimental to satisfactory performance.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Remove defective concrete and rebuild to original profiles.

B. Plug active leaks according to waterproofing manufacturer's instructions.

C. Patch holes and non-moving cracks and joints.

D. Clean and prepare surfaces thoroughly prior to installation; schedule cleaning and preparation so that residue will not fall on newly coated, uncured surfaces.

E. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Use sandblasting, water blasting, or acid etching as recommended.

F. Application of waterproofing constitutes acceptance of substrates.

G. Protect other work from fallout, overspray, and spatter from waterproofing application; provide temporary enclosures and covers as necessary to do so.

3.3 INSTALLATION

A. Install waterproofing in accordance with manufacturer's instructions and recommendations unless more stringent requirements are indicated.

B. Perform installation only during ambient and substrate conditions recommended by manufacturer; provide temporary enclosures and/or temporary heating as necessary to do so.

C. Fill voids and holes prior to application of first coat.

D. Apply the number of coats and at the rates recommended by manufacturer for the specific application but not less than specified minimum thickness; apply at least two coats unless one coat is specifically indicated.

E. At surfaces exposed to view, apply a uniformly textured finish without major variations in appearance.

F. Extend waterproofing to all surfaces in areas indicated to form continuous waterproofed surfaces.

G. Cure waterproofing by recommended methods for recommended period prior to making waterproofed area available for use or occupancy; protect from too rapid drying, severe weather exposure, and water accumulation.
   1. Hot, Dry Weather: Use wet-cure methods regardless of manufacturer's instructions.
   2. Do not use covers that could stain waterproofing surfaces.
   3. Do not use chemical curing agents unless explicitly approved by waterproofing manufacturer.
   4. Do not expose waterproofing to sunlight for minimum of 72 hours after placement.

H. Do not backfill, fill water or liquid holding structures, or apply finish coatings until time period recommended by manufacturer has passed.

3.4 FIELD QUALITY CONTROL - WATER HOLDING STRUCTURES

A. Flood test waterproofing application by filling to capacity and allowing to stand for not less than 24 hours.

B. If any leaks appear, notify Architect and drain.
   1. Repair leaks at no additional cost to Owner.
   2. Repeat flood test until all leakage is eliminated.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 SCHEDULE

A. Surface - applied above or on concrete (vertical /horizontal) protection from water intrusion

B. Pool and water holding structures.

END OF SECTION

SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Crystalline waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference TBD.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

C. Surface shall be protected from rain, frost, or excessive drying for minimum 48 hours following application.

PART 2 – PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Crystalline Waterproofing: Prepackaged, [gray] [white]-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with

water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.

1. Schomburg / AQUAFIN or approved equal suitable for Houma, Louisiana.

2. Water Permeability: Maximum [zero for water at 30 feet (9 m)] hydrostatic pressure when tested according to COE CRD-C 48.

3. Compressive Strength: Minimum [4000 psi (27.6 MPa)] at 28 days when tested according to ASTM C109/C109M.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; and compatible with substrate and other materials indicated.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

C. Water: Potable.

2.3 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

B. Mix only enough material for immediate use; use within working time specified by manufacturer (typically 20 to 30 minutes).

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions and the following practices:

1. Surfaces shall be structurally sound, fully cured, and free of dust, dirt, oil, grease, curing compounds, laitance, paint, form release agents, or other contaminants.

2. Prepare surface by high-pressure water blasting, sandblasting, or equivalent mechanical method to open capillaries and ensure absorption.

3. Do not use acid etching.

4. Ensure surface is in saturated surface-dry (SSD) condition at time of application: uniformly damp but free of standing water.

B. Protect adjacent work from damage caused by preparation or application of waterproofing.

C. Do not allow waterproofing, patching, and plugging materials to enter annular spaces intended for resilient sealants or gaskets.

D. Plug active leaks using manufacturer-approved plugging compound prior to waterproofing.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch (1.6 mm) wide or larger, remove loose material, cut to reveal with sides perpendicular to surface, minimum 1 inch (25 mm) deep. Fill flush with patching compound.

3.2 INSTALLATION

A. Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate prepared surface with clean water for several hours prior to application. Maintain SSD condition.

2. Apply waterproofing uniformly by brush, spray, or trowel in [two] [three] <Insert number> coats to required thickness.

3. Apply second and subsequent coats while the previous coat is green (not fully dry), or pre-dampen if fully dried.

4. Extend waterproofing onto adjacent surfaces:

a. Onto integral columns and footings within treated areas.

b. Minimum 12 inches (300 mm) up vertical surfaces from treated floors.

c. Onto intersecting walls (interior and exterior) as specified.

d. At trenches, sumps, pits, pipe chases, and similar elements.

5. Application shall be continuous and uniform with full contact to substrate and complete coverage of pores and irregularities.

6. Provide neat termination lines and prevent bridging or buildup at edges.

7. Dampen surface between coats.

B. Final Coat Finish: [Smooth] [Brushed] [Spray textured] as required.

C. Do not apply during rain or when substrate is frozen.

D. Coordinate sequencing with other trades to ensure penetrations, embedded items, and surface preparation is complete before application.

3.3 CURING AND PROTECTION

A. Moist-Cure: Begin immediately after final coat has set.

1. Keep surface damp using misting, fog spray, or wet burlap for a minimum of [3] days.

2. Prevent surface from drying out during curing period; protect from frost, rain, and direct sun.

3. Do not use curing compounds or plastic sheeting unless approved by manufacturer.

B. Prevent damage to installed coating by foot traffic, backfill operations, or other construction activity.

C. Do not expose treated surfaces to hydrostatic pressure or submersion until full cure is achieved.

END OF SECTION 071616

SECTION 07 18 00 - TRAFFIC COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied membrane coating for waterproofing and traffic surface.

1.2 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

B. ASTM D4259 - Standard Practice for Abrading Concrete; 1988 (Reapproved 2012).

C. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2014.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.

H. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of the work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Requirements, for submittal procedures.

B. Product Data: Include product characteristics and limitations. Identify dissolving solvents, fuels, and potential destructive compounds.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

D. Samples: Submit two samples of cured membrane, 4x4 inch in size, illustrating color, surface texture, and variations.

E. Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer's Installation Instructions: Include special field conditions required to install traffic membrane and potential incompatibilities with adjacent materials.

G. Maintenance Data: Include procedures for stain removal, repairing surface, and cleaning.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing installation of traffic membrane, with minimum three years documented experience and approved by manufacturer.

C. Compatibility: Provide traffic coating, joint sealants, backings, and other related materials that are compatible with one another and with substrates under conditions of service and application, as demonstrated by traffic coating manufacturer, based on testing and field experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Maintain storage area at minimum ambient temperature of 55 degrees F.

B. Keep away from fire or open flame.

1.7 FIELD CONDITIONS

A. Do not install materials when temperature is below 40 degrees F or when surface temperature is above 115 degrees F.

B. Maintain this temperature range, 24 hours before, during and 72 hours after application.

C. Restrict traffic from area where materials are being installed or are curing.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Manufacturer's standard form in which traffic coating manufacturer agrees to repair or replace traffic coatings that deteriorate during the specified warranty period. Warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.
   1. Deterioration of traffic coatings includes the following:
      a. Adhesive or cohesive failures.
      b. Abrasion or tearing failures.
      c. Surface crazing or spalling.
      d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
   2. Warranty Period: Five years from date of Substantial Completion.

C. Applicator's Warranty: Correct defective Work within a two year period after Date of Substantial Completion.
   1. Non-compliance and defective work includes the following:
      a. Adhesive or cohesive failures.
      b. Abrasion or tearing failures.
      c. Surface crazing or spalling.
      d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
   2. Warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.

3. Applicator Maintenance: For two years after completion and acceptance of the traffic coating membrane, provide a 24 hour/7 days per week 1-hour call back response for repair of system failures including leaks.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Polyurethane Traffic Coating:
   1. BASF; MasterSeal Traffic 1500: www,master-builders-solutions.basf.us.
   2. Substitutions: See Section 01 25 00 Substitution Procedures and Substitution Request Form

2.2 TRAFFIC COATINGS

A. Pedestrian Polyurethane Waterproof Coating System: Fluid applied, moisture-curing, polyurethane system with base and top coat.
   1. Finished Coating Thickness: 55 mils, 0.055 inch, minimum.
   2. Color: As selected by Architect.
   3. Manufacturers:
      a. BASF; MasterSeal Traffic 1500: www,master-builders-solutions.basf.us.

2.3 MATERIALS

A. Coatings - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.

B. Membrane: Fluid applied two component polyurethane; waterproof; color as selected; conforming to the following:
   1. Type TC-1, Pedestrian 2 coat system
      a. Base coat, 30 dry mils minimum
      b. Top coat, 15 dry mils minimum
   2. Physical Properties: Meet or exceed manufacturer's published properties.

C. Surfacing: Silica sand, compatible with coating compound, as recommended by coating manufacturer.

D. Elastic Flashings: 60 mil thick neoprene as recommended by coating manufacturer.

E. Joint Cover Sheet: 60 mil think elastic sheet material designed for and compatible with coating.

F. Filler and Primer: As recommended by membrane manufacturer.

G. Sealant: PVC Membrane, butyl rod or other support material, as recommended by membrane manufacturer, and compatible with system and adjacent materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing dimensions and details prior to installation of materials.

B. Verify that substrate is ready to receive work, surface is clean, dry and free of substances that could adversely affect bond.

C. Do not begin work until concrete substrate has cured at least 28 days and moisture content is 16 percent or less.

D. Ensure that curing compound and hardener are compatible with specified coating. Remove incompatible hardeners and compounds according to manufacturer's instructions.

E. Verify that concrete sub-floor surfaces are ready for traffic coating installation by testing for moisture emission rate and alkalinity according to ASTM F1869 procedures; obtain instructions if test results are not within limits recommended by traffic coating manufacturer.
   1. At lightweight concrete, gypsum concrete and patching and leveling compounds, test in accordance with ASTM F2170.

F. Ensure that drains, sleeves and curbs that pass through surfaces to receive coating are properly and rigidly installed.

G. Ensure that surfaces are free of cracks, depressions, waves or projections that may be detrimental to proper installation of coating membrane.

3.2 PREPARATION

A. Clean substrate surface free of foreign matter.

B. Patch concrete substrate with filler to produce surface conducive to bond.

C. Apply 12 inch wide strip of joint cover sheet over cracks, non-working joints, and expansion joints over 1/16 inch, but not exceeding 1/2 inch wide.

D. At expansion joints from 1/2 inch to 1 inch in width, loop cover sheet down into joint a distance of 1-1/4 to 1-3/4 inches. Extend sheet minimum of 6 inches on both sides of expansion joint.

E. Center cover over cracks and joints. Roll sheet into 1/8 inch coating of waterproof membrane. Apply second coat over sheet edge extending a minimum of 6 inches beyond sheet edges.

F. Protect adjacent surfaces.

G. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
   1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
   2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in the reference standard.
   3. Remove and replace areas of defective concrete as specified in Section 03 30 00.
   4. Prepare concrete for adhesive bonded traffic coating using mechanical methods in accordance with ASTM D4259.

H. Temporarily close off deck drains and other deck penetrations to prevent spillage and migration of traffic-coating fluids. Re-open deck drains at the end of each work day or when rain is imminent.

3.3 INSTALLATION

A. Apply system materials in accordance with manufacturer's instructions.

B. Apply primer to prepared substrate at rate recommended by manufacturer.

C. When base coat is tack free, apply one coat of top coating to a minimum dry film thickness recommended by coating manufacturer.

D. Extend primer, base and top coats up intersecting and perimeter vertical surfaces, 4 inches. Terminate top edge in a straight line.

E. Finish to smooth surface sloped to drains. Cove at vertical surfaces.

F. Seal items projecting through coating.

G. Install coating over joints, both static and moving.

H. Do not apply traffic paint for striping and other markings until traffic coating has cured according to manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Verify the applied thickness before the material attains final set, by use of a mil-thickness gauge as the work progresses. Immediately apply additional coating to produce required thickness where readings indicate a thickness less than that specified.

C. Visually inspect areas which cannot be water tested for voids, damage, or rupture. Repair as required.

D. Replace Work or materials damaged beyond repair, in opinion of Architect, at no cost to Owner.

3.5 PROTECTION

A. Allow top coating to cure for 48 hours minimum before permitting traffic on surfaces. At temperatures less than 75 degrees F and relative humidity less the 50 percent, extend curing time.

3.6 CLEANING

A. Clean stains from adjacent surfaces with cleaning agent recommended by coating manufacturer.

B. Remove foreign matter from finished coating surfaces.

END OF SECTION

SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:

1. Cast stone.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.

1. Water Repellents: Comply with performance requirements specified, as determined by testing on manufacturer's standard substrate assemblies representing those indicated for this Project.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.

1. Cast Stone: ASTM C 1195.

C. Water-Vapor Transmission: Comply with one or both of the following:

1. Maximum 15 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96/E 96M.
2. Minimum 90 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

F. Visual Evidence of Water Repulsiveness: Visual inspection.

1. Treated materials give visual evidence of widespread surface hydrophobia: visible beading.

a. Minimum surface area displaying water beading: 100% for first 18 months, 90% through remainder of warranty.

2. Treated materials give little to no evidence of water absorption: surface discoloration, deepening of hue, indicating water penetration.

a. Maximum surface area visibly wetted: 0% for first 18 months, 10% through remainder of warranty.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard colors.
3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

B. Samples: For each type and color of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

C. Qualification Data: For qualified Applicator.

D. Product Certificates: For each type of water repellent, from manufacturer.

E. Preconstruction Testing Reports: For water-repellent-treated substrates.

F. Field quality-control reports.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."

C. Mockups: Apply water repellent to each type of substrate required.

1. Locate each test application as directed by Architect.
2. Size: 25 sq. ft..
3. Final approval by Architect of color and water-repellent application will be from test applications.

1.6 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
5. Rain or snow is not predicted within 24 hours.
6. Not less than three days have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period, as well as materials and surrounding construction damaged from

subsequent water infiltration. This warranty is to include both the replacement of the materials themselves and the cost of the labor to make them seamless.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Siloxane, Penetrating Water Repellent: Clear, containing 15 percent or more solids of oligomerous alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Chemical Products Industries, Inc.; CP-500W.
b. ChemMasters; Aquanil Plus WB.
c. Conproco Corporation; Conpro Shield MX.
d. Dayton Superior Corporation; Weather Worker WB Heavy Duty (J-27-WB).
e. Diedrich Technologies, Inc.; 303-C.
f. Euclid Chemical Company (The), an RPM company; Euco-Guard VOX.
g. H&C Concrete Care Products, Sherwin-Williams Company (The); H&C SX-7.
h. Price Research, Ltd.; Price Aqua Seal-20.
i. Rainguard Products Company; MicroSeal.
j. SaverSystems; DEFY Water Repellent for Brick.
k. Specco Industries, Inc.; Waterstopper S-10 WB Siloxane.
l. Tamms Industries, Inc., Euclid Chemical Company (The); Baracade M.E.
m. Textured Coatings of America, Inc.; Rainstopper 1500.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
4. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

1. Cast Stone: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
2. Portland Cement Plaster (Stucco): ASTM E 1857.

B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using 15 psi-pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Cast Stone: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 19 00

SECTION 07 21 00 – THERMAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY A. Section Includes:

1. Extruded Polystyrene (XPS) Foam-Plastic Board Insulation – Continuous insulation behind masonry, foundation walls, and brick veneer.
2. Polyisocyanurate (Polyiso) Foam-Plastic Board Insulation – Continuous insulation behind metal panels, sheathing, and roofing assemblies.
3. Glass-Fiber Blanket Insulation – Interior soffits, partitions, suspended ceilings; thermal and acoustic applications.
4. Mineral Fiber Board Insulation – Curtain wall spandrel zones, backup walls, and exterior sheathing.
5. Mineral Wool Batt Insulation – Interior and exterior framed walls, spandrels, floors, and soffits; thermal, acoustic, and fire-rated applications.
6. Batt Insulation – Interior framed partitions, floors, and soffits; acoustic and fire-rated applications.
7. Insulation for Miscellaneous Voids – Glass-fiber loose fill or spray polyurethane foam for gaps, shim spaces, and irregular cavities.

B. Related Requirements:

1. Section 05 40 00 – Cold-Formed Metal Framing
2. Section 07 27 26 – Fluid Applied Waterproofing Assembly. s.
3. Section 07 52 16 - Styrene-Butadiene-Styrene (SBS) Modified Bituminous Roofing
4. Section 07 84 46 Fire Resistive Joint systems
5. Section 09 21 16 – Gypsum Board Assemblies: Acoustic insulation.

1.2 REFERENCE STANDARDS

A. ASTM C518 – Thermal Conductivity of Insulation Materials.

B. ASTM C578 – Extruded Polystyrene Foam Board.

C. ASTM C612 – Mineral Fiber Board.

D. ASTM C665 – Glass-Fiber Batt Insulation.

E. ASTM C1289 – Polyisocyanurate Board Insulation.

F. ASTM C764 – Loose-Fill Glass-Fiber Insulation.

G. ASTM C1029 – Spray Polyurethane Foam.

H. ASTM E84 – Surface-Burning Characteristics.

I. ASTM E119 – Fire-Resistance Ratings.

J. UL 263 – Fire-Resistance Assemblies.

K. NFPA 285 – Fire Propagation.

L. ASTM C1114 – Mineral Wool Batt Insulation.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data – Manufacturer's installation instructions, R-value labeling, accessory data; applicable to XPS board, Polyiso board, Glass-fiber blanket, Mineral fiber board, Mineral wool batt, Batt insulation, Miscellaneous void insulation, Accessories.Installation Methods – Detailed installation methods for rated assemblies, cavity walls, framed construction, and miscellaneous voids; applicable to all insulation types.
2. Sample R-Value Labels – Demonstrate correct labeling and dimension compliance; applicable to XPS, Polyiso, Glass-fiber blanket, Mineral fiber board, Batt insulation.
3. Fire-Rated Assembly Compliance – Verification of insulation products in UL or equivalent rated assemblies; applicable to XPS, Polyiso, Mineral fiber board, Batt insulation.
4. Fire-Rated Assembly Compliance – Verification of insulation products in UL or equivalent rated assemblies; applicable to XPS, Polyiso, Mineral fiber board, Mineral wool batt, Batt insulation.

B. Informational Submittals:

1. Product Test Reports – High-heat performance, flame spread, smoke development, surface-burning, and fire propagation; applicable to XPS, Polyiso, Glass-fiber blanket, Mineral fiber board, Batt insulation, Loose-fill, Spray polyurethane foam.
2. ASTM Compliance Reports – Documentation confirming compliance with ASTM standards (C518, C578, C612, C665, C1289, C764, C1029, E84, E119, UL 263, NFPA 285); applicable to all insulation types.
3. Manufacturer Certifications – Verification of product origin, quality, and conformance to specified standards; applicable to all insulation types and accessories.

4. UL / Agency Listings – Copies of listings for rated assemblies, where insulation is part of fire-resistance or high-heat assemblies; applicable to XPS, Polyiso, Mineral fiber board, Batt insulation.

1.4 QUALITY ASSURANCE

A. Prefer insulation products from a single manufacturer where feasible.

B. Fire-rated and UL-rated assemblies must use insulation approved by the applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.6 FIELD CONDITIONS

A. Do not install on wet or frozen substrates or in unsuitable weather conditions.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE (XPS) BOARD

A. For use on exterior walls outside of sheathing line for continuous insulation as required by Energy Code behind brick veneer locations.

B. Extruded Polystyrene Board Insulation, Type IV, with Drainage Panels : ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Owens Corning; Foamular NGX 250 or comparable product by one of the following:
   a. Atlas Wall Insulation (Energy Shield XR)
   b. DuPont de Nemours, Inc. (Styrofoam Square Edge)
2. AT RATED ASSEMBLIES: Where indicated in the Contract Documents provide rigid insulation as specifically required by the UL Listed Assembly or Assemblies indicated regardless of whether or not product appears in the list above as the insulation indicated would be required in order to achieve the rating. When and wherever possible keep insulation in same manufacturer as rest of the Project.

2.3 POLYISOCYANURATE (POLYISO) BOARD

A. For use on exterior walls outside of sheathing line for continuous insulation as required by Energy Code behind metal panel locations

B. Polyisocyanurate Board Insulation, Foil Faced : ASTM C1289, foil faced, Type I, Class 1 or 2.

1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; Thermax™ Basic NH or comparable product by one of the following:
   a. Atlas Polyiso Roof and Wall Insulation - Energy Shield Pro.
   b. Johns Manville; a Berkshire Hathaway company - AP Foil 25.
2. AT RATED ASSEMBLIES: Where indicated in the Contract Documents provide rigid insulation as specifically required by the UL Listed Assembly or Assemblies indicated regardless of whether or not product appears in the list above as the insulation indicated would be required in order to achieve the rating. When and wherever possible keep insulation in same manufacturer as rest of the Project.

2.4 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed; SAINT-GOBAIN.

b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

2.5 MINERAL FIBER BOARD INSULATION

A. ASTM C612, semi-rigid or rigid.

B. Basis-of-Design – Thermafiber FireSpan 90 or equal.

C. Applications – Curtain wall spandrels, backup walls, exterior sheathing.

2.6 BATT INSULATION

A. ASTM C665, unfaced or kraft-faced; flame-spread and smoke-developed per ASTM E84 limits.

B. Basis-of-Design –Basis-of-Design – CertainTeed, Johns Manville, or Owens Corning (glass-fiber batt).Interior framed partitions, floors, soffits; acoustic or fire-rated walls.

C. Applications – Interior framed partitions, floors, soffits; acoustic or fire-rated walls.

2.7 MINERAL WOOL BATT INSULATION

A. ASTM C1114, unfaced or kraft-faced; flame-spread ≤25, smoke-developed ≤50..

B. Basis-of-Design – Roxul ComfortBatt, Thermafiber SAFB, or equal..

C. Applications – Interior and exterior framed walls, spandrels, floors, soffits; acoustic, thermal, or fire-rated assemblies

2.8 INSULATION FOR MISCELLANEOUS VOIDS

A. Glass-fiber loose fill – ASTM C764 Type II, flame-spread 5 (ASTM E84).

B. Spray polyurethane foam – ASTM C1029 Type II, closed-cell; flame-spread ≤75, smoke ≤450.

C. Applications – Fill gaps, shim spaces, and irregular cavities around MEP penetrations.

D. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.9 ACCESSORIES

A. Mechanical fasteners, insulation washers, adhesive, support bars, wire mesh, and other components as required.

B. Vapor retarders/barriers where indicated on Drawings, compatible with insulation type.

C. Joint sealing tapes, sealants, and closure strips per manufacturer's instructions.

PART 3 – EXECUTION

3.1 PREPARATION

A. Clean substrates; remove sharp projections.

B. Verify substrates are dry and suitable for insulation adhesion or mechanical fastening.

3.2 INSTALLATION – GENERAL

A. Install per manufacturer instructions.

B. Fit insulation tightly; avoid voids or compression of blanket/batt insulation.

C. Coordinate with other trades for penetrations, flashing, and rated assemblies.

3.3 INSTALLATION BY APPLICATION

A. XPS Board – Continuous behind masonry, foundation walls, slab edges; adhere or mechanically fasten.

B. Polyiso Board – Continuous behind metal panels, sheathing, roofing systems.

C. Glass-Fiber Blanket – Above ceiling grids or within soffit framing; prevent sagging.

D. Mineral Fiber Board – Fit in curtain wall spandrels; use retainers or T-bars.

E. Mineral Wool Batt – Place in stud wall cavities or framed spandrels; support with wire, mesh, or friction fit; avoid compression to maintain R-value.

F. Batt Insulation – Place in stud wall cavities; support with wire or mesh if exposed.

G. Miscellaneous Voids – Fill with loose-fill glass-fiber or spray polyurethane foam.

3.4 INSTALLATION IN FRAMED CONSTRUCTION

A. Cut insulation to fit cavities; friction-fit or mechanically support as required.

B. Maintain clearances around non-rated recessed lighting.

C. For high metal-stud walls, support unfaced blankets mechanically; tape flanges for faced blankets.

3.5 INSTALLATION OF RIGID BOARD INSULATION

A. Install per manufacturer instructions and project drawings.

B. Abut joints tightly; do not tape or seal unless specified. C. Avoid small, irregular infill pieces.

3.6 PROTECTION

A. Protect installed insulation from moisture, weather, and physical damage.

B. Provide temporary coverings if permanent concealment is not immediate.

END OF SECTION 07 21 00

SECTION 072119 – FOAMED-IN-PLACE INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam (SPF) insulation.
2. Open-cell spray polyurethane foam (SPF) insulation.
3. Ignition barriers for spray foam insulation.

B. Related Requirements:

1. Section 075700 "Coated Foamed Roofing" for spray polyurethane foam insulation used in roofing applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each insulation and ignition barrier product, include:

1. Manufacturer’s technical data sheets.
2. Installation instructions.
3. Surface preparation and curing requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Indicate compliance with ASTM, ICC-ES, and NFPA standards.

B. Research Reports: Provide ICC-ES evaluation reports or equivalent.

PART 2 – PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell SPF Insulation:

1. Type: ASTM C1029, Type II.
2. Minimum Density: 1.5 lb/cu. ft. (24 kg/cu. m).
3. Minimum Aged R-Value at 1 inch (25.4 mm): 6.2°F·h·ft^2/Btu at 75°F (43 K·m^2/W at 24°C).
4. Manufacturers:
   - Johns Manville, or approved equal.

B. Surface-Burning Characteristics (ASTM E84):

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Fire Propagation Characteristics:

1. Complies with NFPA 285 as part of an approved wall assembly.

D. Standards Compliance:
- ASTM C1029
- ASTM E84
- NFPA 285
- ICC-ES AC377

2.2 IGNITION BARRIERS FOR SPRAY FOAM INSULATION

A. Products:

1. Ignition barrier materials compliant with building code for SPF applications in attics, crawl spaces, or concealed areas.
2. Must meet ICC-ES AC377, Appendix X or other applicable standards.

B. Fire Testing Standards:
1. ASTM E84
2. ASTM E119
3. NFPA 286
4. ICC-ES AC377, Appendix X

C. Submittals:

1. Product data sheets for ignition barriers.
2. Fire test reports from approved laboratories.
3. Manufacturer's installation guidelines.

D. Quality Assurance:

1. Installer Qualifications:
   - Manufacturer-trained and certified for SPF and coatings.
2. Mock-Up:
   - Provide a sample area for Owner/Architect review.

E. Delivery, Storage, and Handling:
- Deliver in original sealed containers with clear identification.
- Store in dry, covered conditions per manufacturer's instructions.

2.3 OPEN-CELL SPRAY POLYURETHANE FOAM

A. Open-Cell SPF Insulation:

1. Blowing Agent: Water-based.
2. Minimum Density: 0.4 lb/cu. ft. (6.4 kg/cu. m).
3. Minimum Aged R-Value at 1 inch (25.4 mm): 3.4°F·h·ft^2/Btu at 75°F (24 K·m^2/W at 24°C).

4. Manufacturers:
   - Johns Manville, or approved equal.

B. Surface-Burning Characteristics (ASTM E84):

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Fire Propagation Characteristics:

1. Complies with NFPA 285 as part of an approved wall assembly.

D. Standards Compliance:
- ASTM E84
- NFPA 285
- ICC-ES AC377

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
- Install in accordance with manufacturer's written instructions.

B. Application:

1. Apply foam to completely envelop all insulated areas and fill voids.
2. Apply in multiple lifts, not exceeding manufacturer's recommended maximum thickness per pass.
3. Do not apply into rising foam; allow curing between passes as required.

C. Ignition Barrier Application:
- Install ignition barrier coating where required, in accordance with manufacturer's installation guidelines and code requirements.

END OF SECTION 072119

SECTION 072726 –

FLUID-APPLIED MEMBRANE AIR BARRIERS

FLUID- APPLIED MEMBRANE VAPOR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections.

1.2 SUMMARY

A. Section Includes:

1. Fluid-applied, vapor-permeable air barrier system.
   Basis-of-Design: PROSOCO R-Guard Cat 5 or approved equal.
2. Fluid-applied, vapor-impermeable air and vapor barrier system.
   Basis-of-Design: PROSOCO R-Guard VB.or approved equal.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
2. Division 07 sections for coordination with roofing, waterproofing, and below-grade vapor barriers.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

D. Vapor-Barrier. is a continuous barrier with very low water vapor permeance, intended to prevent or significantly limit water vapor transmission from one side of a wall, ceiling, or floor to the other.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review air and vapor barrier requirements and installation, special details, mockups, air-leakage and bond testing, barrier protection, and work scheduling that covers both barriers.
2. Coordination with other envelope trades to ensure continuity of air and vapor barrier assemblies.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; wet and dry film thickness; and tested physical and performance properties of products.
2. Include letter from manufacturer that indicates acceptable other flashing materials for adhered or other acceptable means of installation for flashing materials and their integration with the fluid applied system that does not negatively affect the system or warranty.
3. Include letters confirming compatibility with other air / vapor -barrier, vapor barrier or waterproofing systems.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For air / vapor-barrier assemblies.

1. Show locations and extent of air / vapor barrier materials, vapor-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, adhered flashings, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air and vapor barrier.
4. Consult air barrier and vapor barrier manufacturer for additional installation guidelines illustrations to assist with meeting shop drawing requirements.
5. Provide detailing of transitions to roof, floor slabs, and other envelope components.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier and vapor barrier manufacturer, certifying compatibility of barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

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C. Product Test Reports: For each barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

E. Include documentation of environmental limitations and substrate conditions at time of installation.

1.7 QUALITY ASSURANCE

A. Pre-Construction Meeting.

1. Contractor to provide written agenda and hold meeting prior to any work in order to review mock ups and project specifics, unique conditions and provide minutes of the meeting.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. A company experienced in applying air and vapor barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
2. Verification that Installer completed SWR Institute's Validated Air Barrier and Vapor Barrier Training Program and is approved to perform work as herein specified by air/vapor and water-resistive barrier system and manufacturer.
3. Verification of completion of ABAA or SWR Institute training program

C. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly , 150 sq. ft. , incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, vapor barriers and sealing of gaps, terminations, and penetrations of air-barrier and vapor barrier assembly. Include roof tie-ins and foundation intersections in mockup scope.
   a. Coordinate construction of mockups to permit inspection and testing of air and vapor barriers before external insulation and cladding are installed.
   b. Include junction with roofing membrane , building corner condition, and foundation wall intersection.
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air and vapor barriers until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Manufacturer's Representative: Manufacture's authorized representative is required to visit the site and submit approval in writing that the installation has met the manufacturer's written installation instructions.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier and Vapor Barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers .
2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
3. Adhesion Testing: Mockups will be tested for required air-barrier and vapor barrier adhesion to substrate according to ASTM D 4541.
4. Alternative Adhesion Testing: Mock-ups will be tested for minimum air-barrier and vapor barrier adhesion using the ABAA 16psi air-barrier and vapor barrier membrane requirement as a minimum adhesion of all non-sealant materials using the PROSOCO Field Adhesion Tester or a unit described in ASTM D 4541. All non-sealant items shall be adhesion-tested in the same manner as the air-barrier and vapor barrier membrane. Sealant adhesion testing shall be performed in accordance with the Dow Corning Americas Technical Manual (page 74).
5. Compatibility Determinations: Mock-ups will be inspected for visual signs of decay, chemical attack, or degradation of any kind. Suspect instances shall be reported to the corresponding manufacturer who shall provide a letter that approves moving forward with the project or rejects the use of the product or rejects the method or circumstances of installation with an appropriate explanation of the position taken.
6. When the mock-up testing and compatibility determinations are complete, the Contractor shall submit documentation clarifying all conditions that were reviewed in the mock-up, stating all materials, details and assemblies that are: 1.) exhibited in the mock-up that are in compliance with the Contract Documents, 2.) exhibited in the mock-up that vary from the Contract Documents, and the reasons they vary, and 3.) exhibited in the mock-up that are not shown in the Contract Documents and why they need to be addressed and reviewed now as part of the mock-up process. Decisions made as a result of the mock-up reviews should be noted in this document and accepted via sign-off by all parties.
7. Submit full documentation clarifying all reviewed mockup conditions and deviations from contract documents.
8. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Sequence deliveries to avoid delays, and to minimize on-site storage.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Deliver materials and products in labeled packages.

D. Store and handle in strict compliance with manufacturer's instructions and recommendations.

E. Protect from damage, weather, excessive temperatures, and construction operations.

F. Remove damaged material from site and dispose of in accordance with applicable regulations.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier and vapor barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier and vapor barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier and vapor barrier performance.
2. Do not apply air barrier or vapor barrier to a damp or wet substrate or during snow, rain, fog, or mist.
3. Verify moisture content on concrete via ASTM D 4263 plastic sheet test if applicable

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-/ vapor barrier materials and air/ vapor barrier accessories from single source from single manufacturer.

B. Low-Emitting Materials: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

For PROSOCO R-Guard Cat 5 (vapor-permeable):

PRODUCT TEST RESULTS
R-Guard Cat 5™

PROSOCO

ICC-ES AC212[1] Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing			
TEST	**METHOD**	**CRITERIA**	**RESULTS**
Tensile Bond	ASTM C 297	Minimum 15 psi (105 kPa)	Pass
Freeze-Thaw	ICC-ES AC212	No cracking, checking, crazing, erosion, delamination or other deleterious effects	Pass
Water Resistance	ASTM D 2247	No cracking, checking, crazing, erosion, delamination, or other deleterious effects	Pass
Water Vapor Transmission	ASTM E 96 Wet Cup	Report	14 perms
Water Penetration	ASTM E 331	No visible water penetration at the sheathing joints as viewed from the back of the panel	Pass
Structural, Racking, Restrained Environmental Conditioning & Water Penetration	ASTM E 1233 A ASTM E 72 ICC-ES AC212 ASTM E 331	No cracking of the coating	Pass
Weathering	ICC-ES AC212 AATCC[2] 127	No cracking of the coating; no water penetration	Pass
Air Permeance	ASTM E 2178	≤ 0.02 L / s·m² at 75 Pa (≤ 0.004 cfm / ft² at 1.57 psf)	Pass: 0.0007 L / s·m² at 75 Pa (0.000 cfm / ft² at 1.57 psf)
ABAA: Air Barrier Association of America Acceptance Criteria for Liquid Applied Membranes			
TEST	**METHOD**	**CRITERIA**	**RESULTS**
Air Permeance	ASTM E 2178	≤ 0.02 L / s·m² at 75 Pa (≤ 0.004 cfm / ft² at 1.57 psf)	Pass: 0.0007 L / s·m² at 75 Pa (0.000 cfm / ft² at 1.57 psf)
Air Leakage of Air Barrier Assemblies	ASTM E 2357	≤ 0.2 L / s·m² at 75 Pa (≤ 0.04 cfm / ft² at 1.57 psf)	Pass: 0.0009 L / s·m² at 75 Pa (0.0028 cfm / ft² at 1.57 psf)
Water Resistance	AATCC 127	No water infiltration after exposure to 55 cm head of water for 5 hours	Pass
Fastener Sealability	ASTM D 1970	No water infiltration	Pass
Pull Adhesion	ASTM D 4541	110 kPa (16 psi) or substrate failure	Pass
Crack Bridging	ASTM C 1305	Pass	Pass
Water Vapor Transmission	ASTM E 96 Wet Cup Dry Cup	Report	Wet Cup: 14 perms Dry Cup: 10 perms
Fire Testing			
TEST	**METHOD**	**CRITERIA**	**RESULTS**
Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies	NFPA[3] 285	Must resist flame propagation and flame spread	See Report 10261K Rev. 6 from Priest & Associates Consulting, LLS
Surface Burning Characteristics	ASTM E 84	Criteria for ICC and NFPA Class A Building Material: Flame Spread ≤ 25 Smoke Developed ≤450	Meets Class A Building Material Flame Spread: 25 Smoke Developed: 10

All testing conducted by independent, accredited laboratories.

NOTES:
1: International Code Council Evaluation Service Acceptance Criteria 212
2: American Association of Textile Chemists and Colorists
3: National Fire Protection Association

For PROSOCO R-Guard VB (vapor-impermeable):

PRODUCT TEST RESULTS
R-Guard VB

PROSOCO

TEST	METHOD	CRITERIA	RESULTS
Water Vapor Transmission	ASTM E 96 Dry Cup	Measure	0.063 perms
Water Resistance	ICC-ES AC212[1] AATCC[2] 127	No water infiltration after exposure to 55 cm head of water for 5 hours	Pass
Air Permeance	ASTM E 2178	≤ 0.02 L / s·m² at 75 Pa (≤ 0.004 cfm / ft² at 1.57 psf)	Pass
Air Leakage of Air Barrier Assemblies	ASTM E 2357	≤ 0.2 L / s·m² at 75 Pa (≤ 0.04 cfm / ft² at 1.57 psf)	Pass
Fastener Sealability	ASTM D 1970	No water infiltration	Pass
Pull Adhesion	ASTM D 4541	110 kPa (16 psi) or substrate failure	Pass
Surface Burning Characteristics	ASTM E 84	Criteria for ICC and NFPA Class A Building Material: Flame Spread ≤ 25 Smoke Developed ≤450	Meets Class A Building Material Pass
Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies	NFPA[3] 285	Must resist flame propagation and flame spread.	See Report 10261K Rev. 6 from Priest & Associates Consulting, LLS

All testing was completed by independent, accredited laboratories.

NOTES:
1: International Code Council Evaluation Service Acceptance Criteria 212
2: American Association of Textile Chemists and Colorists
3: National Fire Protection Association

2.3 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier and vapor barrier manufacturer to produce a complete air-barrier and vapor barrier assembly and that are compatible with primary air-barrier and vapor barrier material and adjacent construction to which they may seal.

Accessories shall also be compatible with the vapor barrier properties of the primary material where vapor-retarding performance is required.

1. Liquid-type auxiliary materials shall comply with VOC requirements.
2. Wet-weather accessories compatible with the primary Wet-Weather Fluid Applied Vapor-Permeable Membrane System shall be comprised of Silyl-Terminated-Poly-Ether (STPe).

B. Primer: If and as required by manufacturer / system and applicable locations provide liquid waterborne primer recommended for field-cut edges of external gypsum board substrate by air-barrier/vapor barrier material manufacturer for the purpose of consolidating friable edges.

Primer shall not adversely affect vapor permeability or vapor-retarding properties of air / vapor barrier.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD GypPrime or comparable product by one of the following:
   a. Primers by barrier manufacturer or as recommened or approved for use with manufacturer's product provided on Project .

C. Joint Reinforcing: Sheathing and rough opening seams and joints Filler Material. Liquid Silyl-Terminated-Poly-Ether (STEp) as recommended for treatment of rough openings.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD Joint & Seam or comparable product by one of the following:
   a. WR Grace .
   b. Henry

D. Rough Opening Flashing Material: Liquid Silyl-Terminated-Poly-Ether (STPe) as recommended for treatment of rough openings.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD FastFlash or comparable product by one of the following:
   a. WR Grace .
   b. Henry

E. Substrate-Patching Material: Manufacturer's standard substrate filler as recommended for preparation of cracks and overdriven fasteners, as recommended by barrier manufacturer.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD Joint & Seam Filler per manufacturer’s recommendations or comparable product by one of the following:
   a. Carlisle
   b. GCP .
   c. Henry
   d. Prosoco
   e. Tremco

F. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

G. Preformed Extrusion: If and as required by Manufacturer, provide manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlisle
   b. GCP .
   c. Henry
   d. Prosoco
   e. Tremco

H. Interior Air or vapor Sealant: Single component, moisture curing, 98 percent solids Silyl-Terminated-Polyether (STPe) to produce a durable, high-performance, high-movement sealant for windows and doors.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD Dam or comparable product by one of the following:
   a. WR Grace .
   b. Henry
2. Backer Rod: Compressible, closed cell rod stock as recommended by manufacturer for compatibility with sealant. Provide size and shape of rod to control joint depth.

PART 3 - EXECUTION

3.1 GENERAL

A. It is the intent that installation of Fluid Applied Membrane Air Barriers and Vapor Barriers will create a continuous, non interrupted barrier throughout the entire plane in which it is installed. Contractor is responsible to identify and address all penetrations, bridging conditions and tie ins with other materials as required to achieve a continuous barrier as noted herein.

B. Provide overlapping of membranes by a minimum of 12” with taped joints.

3.2 EXAMINATION

- Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by barrier manufacturers.
3. Verify that substrates are visibly dry and free of moisture, unless approved by air / vapor barrier manufacturer. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air/vapor barrier application.

1. Surfaces STPe accessory materials may be dry, damp, or wet to the touch. Brush away any standing water present before application. The products will tolerate rain immediately after application.
2. If installing directly over metal studs provide over only un-punched, solid, studs.

B. Mask off adjoining surfaces not covered by barriers to prevent spillage and overspray affecting other construction.

C. Remove film-forming coatings, curing compounds, and form-release agents from concrete, and grease, oil, bitumen, paints, and other contaminants from all substrates.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another. See STPe product manufacturer's installation guidelines illustrations.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for barriers.

H. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air/ vapor barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

I. Exterior Sheathing:

1. Ensure that sheathing is properly installed with ends, corners, and edges properly fastened. Remove and replace damaged sheathing.

2. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing, fastened and spotted with substrate patching material, and fastened into solid backing.
3. Consolidate and seal the cut edges of gypsum wall boards exposed in rough openings for windows and doors at corners. The treated edge provides a suitable surface for application of joint reinforcing, fiber-reinforced coat and seam treatment.

J. Apply primer to substrates at required rate and allow it to dry, as recommended by barrier manufacturers.

3.4 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and barrier manufacturer's written instructions.
2. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

B. Gypsum Sheathing: Fill joints greater than 1/2 inch with joint reinforcing according to barrier manufacturer's written instructions.

1. Fill surface defects and over driven fasteners.
2. Using a dry knife, trowel, or spatula, tool and spread the product. Spread 1 inch beyond seam at each side to manufacturer's recommended thickness. See manufacturer's product data sheet.
3. Allow to skin before installing other waterproofing or barrier components.
4. Apply in accordance with barrier manufacturer's written instructions.

3.5 ACCESSORIES INSTALLATION

A. Install accessory materials according to barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of barrier.

1. Coordinate the installation of barrier with installation of roofing membrane and base flashing to ensure continuity of barrier with roofing membrane. See manufacturer's installation guidelines illustrations.
2. Install transition strip or liquid-seal materials on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

B. Connect and seal exterior wall barrier material continuously to roofing-membrane barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, penetrations, and doors to seal and waterproof rough openings, as recommended by barrier

manufacturer. Substrates for STPe products do not require primers other than field-cut edges of external gypsum board, such as around rough openings.

1. Apply a thick bead of Rough Opening Joint & Seam Filler over all joints and seams of the rough opening.
2. Apply Rough Opening Filler Material within temperature and weather limitations as required by manufacturer.
3. Apply Rough Opening Filler Material to perimeters, sills, and adjacent sheathing and building face, in accordance with manufacturer's product data sheet and manufacturer's Installation Guidelines illustrations.
4. Apply liquid STPe flashing product to interior surfaces of rough opening and out onto the sheathing or CMU per manufacturer’s instructions.
5. Preformed Silicone Extrusion: Install as recommended by air / vapor barrier manufacturer.

D. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air/ vapor barrier material as recommended by air / vapor barrier manufacturer.

E. Seal masonry reinforcing or ties and penetrations as recommended by air / vapor barrier manufacturer.

F. Seal top of through-wall flashings to air / vapor barrier as recommended by air / vapor barrier manufacturer.

G. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets as recommended by air / vapor barrier manufacturer.

H. Repair punctures, voids, and deficient lapped seams in strips and transition strips as recommended by air / vapor barrier manufacturer.

3.6 PRIMARY BARRIER MATERIAL INSTALLATION

A. Apply barrier material to form a seal with strips and transition strips and to achieve a continuous barrier per manufacturer's written instructions and details. Apply barrier material within manufacturer's recommended application temperature ranges. Air / vapor barrier to be installed so as to create a continuous barrier tying separate components of the building envelope together. This includes connection to the slab and roof systems as well as all other components of the building envelope. The barrier is to be continuous at all joints, terminations and penetrations even where not specifically detailed as such.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. Medium-Build Barriers: Apply continuous unbroken barrier material to substrates according to the thickness required by the barrier manufacturer for the Project conditions. Apply an increased thickness of air / vapor barrier material in full contact around protrusions such as masonry ties.

1. Barrier: Apply dry film thickness as recommended by barrier manufacturer's literature to comply with performance requirements. Apply additional material as needed to achieve void- and pinhole-free surface.

C. Low-Build Barriers: Apply continuous unbroken air / vapor barrier material to substrates according to the following thickness. Apply an increased thickness of air / vapor-barrier material in full contact around protrusions such as masonry ties if applicable.

1. Vapor-Permeable, Low-Build Barrier: Apply dry film thickness as recommended by air / vapor barrier manufacturer's literature to comply with performance requirements. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

D. Do not cover air /vapor barrier until it has been tested and inspected by testing agency.

E. Correct deficiencies in air / vapor barrier that does not comply with requirements; repair substrates and reapply air / vapor-barrier components.

3.7 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Manufacturer's authorized representative shall inspect the following and submit a report of his findings to the Architect. Air/ vapor barrier materials, accessories, and installation are subject to inspection for compliance with requirements.

1. Continuity of barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Wet mil thickness readings: Take during material application with photo documentation provided with daily field reports. Provide 1 gauge reading for every 500 SF of installed material and not less than a minimum of 1 per wall face.
3. Air / vapor barrier dry film thickness.
4. Continuous structural support of air/vapor-barrier system has been provided.
5. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
6. Site conditions for application temperature and dryness of substrates have been maintained.
7. Maximum exposure time of materials to UV deterioration has not been exceeded.
8. Surfaces have been primed, if applicable.
9. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
10. Termination mastic has been applied on cut edges.
11. Strips and transition strips have been firmly adhered to substrate.
12. Compatible materials have been used.
13. Transitions at changes in direction and structural support at gaps have been provided.

14. Connections between assemblies (air / vapor barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
15. Tie offs and connections to disparate systems such as the roof have been made in accordance with the manufacturer's requirements.
16. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air / vapor-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers .
2. Air-Leakage-Volume Testing: Air / vapor-barrier assemblies will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
3. Adhesion Testing: Air / vapor barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air vapor barrier or part thereof.

E. Barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air / vapor -barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air/ vapor barrier components for retesting as specified above.

F. Repair damage to barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. Protect air/vapor-barrier system and vapor- barrier from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace barrier or install additional, full-thickness, barrier application after repairing and preparing the overexposed materials according to barrier manufacturer's written instructions.
2. Protect air / vapor barrier from contact with incompatible materials and sealants not approved by barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 07 4213.24 ALUMINUM METAL WALL

PART 1- GENERAL

1.01 SECTION INCLUDES

A. Aluminum metal plate wall panels

1.02 RELATED REQUIREMENTS

A. Section 05 40 00 – Cold-Formed Metal Framing: Wall panel substrates support framing.

B. Section 06 10 00 – Rough Carpentry: Plywood substrate wall sheathing.

C. Section 07 27 26 – Fluid Applied Membrane Barriers: Air and moisture barrier required as part of metal wall panel assembly.

D. Section 07 62 00 – Sheet Metal Flashing and Trim: Field formed flashings and other sheet metal work.

E. Section 07 92 00 – Joint Sealants: Perimeter sealant.

1.03 DEFINITION

A. Metal Plate Wall Panel and Soffit Assemblies: Metal plate wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weather tight wall system based on AAMA CW-RS-1.

1.04 REFERENCE STANDARDS

A. AAMA - American Architectural Manufacturers Association (www.aamanet.org)
   1. AAMA CW-RS-1 – The Rain Screen Principle and Pressure Equalized Wall Design; 2012
   2. AAMA 501.1 – Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2005
   3. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2009
   4. AAMA 508 – Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems; 2014 [Testing based on 2007 Edition]
   5. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014
   6. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013 [Testing based on 2005 Edition]

B. ASTM International (American Society for Testing and Materials; www.astm.org)
   1. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015
   2. ASTM D523 - Standard Test Method for Specular Gloss; 2014
   3. ASTM D2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2015
   4. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity; 2011
   5. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 07(2015)
   6. ASTM E8/E8M - Standard Test Methods for Tension Testing of Metallic Materials; 2013a
   7. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 04(2012)

8. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014
9. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 00(2009)
10. ASTM E1233/E1233M – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential; 2014 [Testing based on 2006 Edition]

C. TAS - Testing Application Standards; Florida Building Code, 2010
1. TAS 202 – Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure Loading; 1994
2. TAS 203 – Criteria for Testing Products Subject to Cyclic Wind Pressure Loading; 1994

D. NAAMM – National Association of Architectural Metal Manufacturers

E. SMACNA – Sheet Metal and Air Conditioning Contractor's National Association

F. PS - Voluntary Product Standard; National Institute of Standards and Technology (NIST)
1. PS-1 – Structural Plywood; 2009

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate panel assemblies with rain drainage, flashing, trim, stud back-up, soffits, and other adjoining work.

B. Preinstallation Meeting:
1. Attendees:
   a. Owner.
   b. Architect.
   c. Installer.
   d. Panel manufacturer's representative.
   e. Structural support installer's.
   f. Installer's whose work interfaces with or affects wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule.
3. Verify availability of materials, installer's personnel, equipment, and facilities needed to maintain schedule.
4. Review means and methods related to installation, including manufacturer's written instructions.
5. Examine support conditions for compliance with requirements, including alignment and attachment to structural members.
6. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affects this Work.
7. Review temporary protection requirements for during and after installation of this Work.

1.06 SUBMITTALS

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. Product Data: Submit for each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal plate wall panel and accessory.

C. Shop Drawings: Submit fabrication and installation layouts of metal plate wall panels; including details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
1. Provide distinction between factory-assembled, shop-assembled, and field-assembled work.
2. Provide details of following items at full scale.
   a. Manufacturer's standard sheet metal trims.
   b. Components of wall panel construction, anchorage methods, and hardware.

D. Coordination Drawings: Submit exterior elevations, drawn to scale, that have the following items shown and coordinated with each other, using input from installers of the following items:
   1. Metal plate wall panels and attachments.
   2. Girts.
   3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
   4. Penetrations of wall by pipes and utilities.

E. Samples: Submit for each type of exposed finish required, and prepared on samples of size as follows:
   1. Aluminum Metal Plate Wall Panels: At least 2 inch by 3 inch.

F. Test and Inspection Reports: Submit test and inspection reports on each type of wall panel system provided for project based on evaluation of comprehensive tests performed by qualified testing agency.

G. Maintenance Data: Submit maintenance data for metal plate wall panels.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least five years of documented experience.

B. Installer: Company specializing in performing work of this section and approved by manufacturer.
   1. Install system in strict compliance with manufacturer’s installation instructions.

C. Anodized Finish Applicator: Provide either caustic (traditional) or eco-friendly (acid) etching technologies.
   1. Use fully automated, computer-controlled process lines for consistency of finish throughout project.
   2. Use documented production line quality control protocols in accordance with AAMA 611 test procedures.

D. Source Limitations: Obtain each type of metal plate wall panel from single source and from single manufacturer.

1.08 MOCKUPS

A. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and to establish quality standards for fabrication and installation.
   1. Build mockup of typical wall panel assembly**,** including corners and corner soffits, supports, attachments, and accessories.
      a. Include at least four panels to represent a four-way panel joint and showing full thickness.
   2. Water Spray Test: Conduct water-spray test of mockup metal panel assembly, test water penetration in accordance with AAMA 501.2.
   3. Approval of mockups does not constitute approval of deviation from Contract Documents within mockups unless these deviations are approved by Architect in writing.
   4. Subject to compliance with requirements, approved mockups **[may]** or **[may not]** become part of completed Work if undisturbed upon Date of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling: Store materials in clean, dry, interior area in accordance with manufacturer’s instructions.

C. Deliver panels, components, and other manufactured items without damage or deformation.

D. Protect panels during transportation, handling, and installation from weather, excessive temperatures and construction operations.

E. Handle panels in strict compliance with manufacturer's instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface damage.
   1. Store panels vertically with top of panel down, storage of panels horizontally is not permitted.

F. Store panels covered with suitable weather tight and ventilated covering.

G. Provide storage of panels to ensure dryness, with positive slope for drainage of moisture.

H. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

I. Remove strippable protective covering from aluminum panel prior to installation.

1.10 SITE CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work to be performed according to manufacturer's installation instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before panel fabrication and indicate measurements on Shop Drawings.
   1. Coordinate with construction schedule.

1.11 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Wall System Warranty: Provide wall panel manufacturer warranty, agreeing to correct defects in manufacturing of materials within a one year period after Date of Substantial Completion.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking, or puncturing.
      b. Deterioration: Beyond normal weathering of wall system metals and other materials.

C. Panel Material Warranty: Provide panel material manufacturer warranty, agreeing to repair finish of metal plate wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 30 years from Date of Substantial Completion. Warranties for all coating systems to be the same.
   2. Warranty Coverage: In accordance with AAMA 2605 for 70 percent PVDF resin on aluminum finish requirements.
      a. Fading, Loss of Color Retention: Loss of 5 Delta E units (Hunter) or less, in accordance with ASTM D2244.
      b. Chalking, Chalky White Powder on Panel Surface: Chalking at No. 8 or less for colors, or No. 6 for white, in accordance with ASTM D4214.
      c. Loss of Adhesion: Loss of 10 percent due to cracking, checking or peeling, or failure to adhere to bare metal.
      d. Gloss Retention: 50 percent or less in accordance with ASTM D523.
      e. Salt Spray, Accelerated: At least 4,000 hours in accordance with ASTM B117.
      f. Humidity Testing, Accelerated: At least 4,000 hours in accordance with ASTM D2247.
   3. Warranty Coverage: In accordance with AAMA 611 Class 1 anodized aluminum finish requirements.
      a. Loss of Adhesion: Resists cracking, crazing, flaking, and blistering when forming and welding completed prior to finishing; post forming or welding voids warranty.
      b. Fading - Loss of Color Retention: Loss of 5 Delta E units (Hunter) or less, in accordance with ASTM D2244.
      c. Chalking, Chalky White Powder on Panel Surface: Chalking at No. 8 or less in accordance with ASTM D4214.
      d. Test Chlorine resistance in accordance with ASTM rD543.
      e. Coating shall show no blistering, rusting, or degradation after 3,000 hours exposure in a modified ASTM B117 test using a 0.5% sodium hypochlorite solution."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Dri-Design – Aluminum Wall Panel System or approved equal, Basis of Design.
   1. Address: 12480 Superior Ct., Holland, Michigan 49424.
   2. P.O. Box 1286 Holland, Michigan 49422-1286.
   3. Phone: (616) 355-2970; Fax: (616) 355-2972; Website: www.dri-design.com.

2.02 PERFORMANCE REQUIREMENTS

Delegated Design for Metal Wall: Basis of Design: Dri-Design

A. Metal panels and support framing, including panel attachment clips, sub girts, zee clips, sill angles, fasteners for miscellaneous metal framing, plates and bars, Tubes and pipes, joints, etc.

B. Metal Plate Wall Panel Assemblies: Comply with performance requirements without failure due to defective manufacturing, fabrication, installation, or other construction defects

C. Design, fabricate, and erect a dry joint, pressure equalized rainscreen aluminum wall panel system without use of sealants, gaskets, or butyl tape, tested as installed in compliance with AAMA 508, and as follows:
   1. Cyclic Static Air Pressure Differential: Pass cycled pressure loading at 25 psf in 100 three-second cycles in accordance with ASTM E1233/E1233M.
   2. Air Infiltration: Pass when tested at 1.57 psf (25 mph) in accordance with ASTM E283.
   3. Water Penetration:
      a. Static: Pass water penetration test under 25.0 psf positive static air pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with ASTM E331.
      b. Dynamic: Pass water penetration test under 15.0 psf dynamic pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with AAMA 501.1.
   4. Structural: Provide systems tested in accordance with ASTM E330/E330M and certified to be without permanent deformation or failure of structural members.

D. High Velocity Hurricane Zone (HVHZ): Comply with ASTM E8/E8M test methods and performance requirements of Florida Building Code and Miami-Dade County test protocols TAS-202 and TAS-203 for HVHZ with at least plus 61 psf to minus 80 psf design pressure rating.
   1. Application: For aluminum plate thickness of 0.080 inch only.

2.03 MATERIALS

A. Dri -Design - Aluminum Plate: Alloy and temper as recommended by manufacturer for application and in compliance with manufacturers design requirements. Refer to drawings for locations.
   1. Aluminum Material: Tension-leveled, [flouropolymer PVDF painted finish, 3003-H14 manganese alloy] or [anodized finish, 5005-AQ manganese alloy].
   2. Thickness: 0.080 inch.
   3. Weight: Less than 2 lbs per sf.
   4. Color: Refer to drawings for color selections.
   5. Panel Depth: 1-1/4 inch, nominal.
   6. Specifier Note: Maximum panel size for aluminum is 48w x 48h inch, square; 24w x 72h inch, rectangular; 60w x 30h inch, rectangular; 120w x 24h inch, long rectangular.
   7. Panel Size: As indicated on Drawings
   8. Specifier Note: Panel joints are typically 1/2 inch wide for horizontal joints and 5/8 inch wide for vertical joints; 1 inch maximum for each.
   9. Panel Joints: As indicated on Drawings.

2.04 FABRICATION

A. Fabricate and finish wall panels within manufacturer's facilities and fulfill indicated performance requirements demonstrated by laboratory testing.
   1. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide post-finishing of panels, paint aluminum wall panels only after completion of panel fabrication and ensure exposed edges are coated.

C. Provide post anodizing of panels, anodize aluminum wall panels only after completion of panel fabrication and ensure exposed edges are anodic coated without crazing of surface at formed edges.

2.05 FINISHES

A. Comply with NAAMM's - Metal Finishes Manual for Architectural and Metal Products, for recommendations of designating finishes.

B. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride (PVDF) resin system.
   1. **All metal wall panels located within the natatorium** and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.
   2. **All metal wall panels located elsewhere in project shall receive Two-Coat Fluropolymer** AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.
   3. **No anodized Finish allowed within the natatorium** and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure. These areas shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

C. Color Anodized Finish: AAMA 611, Architectural Class I, color anodized coating of 0.0007 inch (0.7 mils) minimum thickness.
   1. Color: From Manufacture's full range. See drawings.

D. Clear Anodized Finish: AAMA 611, Architectural Class I, clear anodized coating of 0.0007 inch (0.7 mils) minimum thickness.

E. Field Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 ACCESSORIES

A. Metal Plate Wall Panel Accessories: Provide components required for a complete metal plate wall panel assembly including trim, copings, fascia, mullions, sills, corner units, flashings, and similar items. Match material and finish of panels unless otherwise indicated.

B. Provide integral drainage system and manufactures standard extrusions at termination of dissimilar materials.

C. Flashing and Trim: Match material, finish, and color of adjacent wall panels.
   1. Thickness: At least 0.040 inch.
   2. Refer to Section 07 62 00 Sheet Metal Flashing and Trim..

D. Panel Fasteners: Designed to withstand design loads, with at least 7/16 inch diameter head and neoprene washer.
   1. Aluminum Wall Panel Material: Provide stainless steel fasteners, or coated fastener approved by panel manufacturer or project wall consultant.

E. Sub-Girts: Galvanized, provide size and gage in accordance with project requirements.
   1. Furring Channel: Provide Hat, C, U or Z type as recommended by manufacturer.

2. Flat Strap: At least 14 gage, 0.0747 inch (1.90 mm) thick.
3. Refer to Section 05 40 00 Cold Formed Framing.

F. Substrate Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I, at least 5/8 inch thick.
1. Refer to Drawings and Section 06 1000 Rough Carpentry for requirements.

G. Weather Barriers: Provide climate specific weather barrier with performance characteristics for air penetration, water vapor transmission, and water penetration resistance. Refer to Section 07 27 26 Fluid Applied Membrane Air Barriers for requirements.

H. Sealants: As recommended by metal panel manufacturer for openings within wall panels and perimeter conditions.
1. Refer to Section 07 92 00 Joint Sealants for requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, and Work areas and conditions with Installer present for compliance with requirements for installation tolerances, wall panel supports, and other conditions affecting performance of this Work.

B. Examine wall framing to verify that girts, angles, channels, studs, and other structural wall panel support members and anchorage have been installed within alignment tolerances required by wall panel manufacturer.

C. Verify that weather barrier has been installed over sheathing or substrate to prevent air infiltration or water penetration.

D. Examine rough-in for components and systems penetrating wall panels to coordinate actual penetration locations relative to wall panel joint locations prior to installation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Framing: Install sub girt, base angles, sills, furring, and other wall panel support members and provide anchorage in accordance with ASTM C754 for gypsum panel type substrates and panel manufacturer’s installation instructions.

3.03 INSTALLATION

A. Install wall and soffit panels in accordance with manufacturer's installation instructions, including pressure equalized rainscreen installation method and installation guidelines.
1. Metal panels consist of single sheets of metal formed with interlocking gutter and drainage system integral to the panel with single horizontal attachment for dry-joint rainscreen assembly.
2. Use of secondary drainage channels, brackets, support pins, joint sealants or gaskets to manage the drainage of wall panel system is not permitted.
3. Attach metal panels using progressive interlocking method, engaging bottom of panel in top of previous panel working bottom up, and left to right.
4. Install metal panels with single top attachment in pre-punched holes to allow individual panels to move due to thermal expansion.
5. Do not compromise internal gutter.

B. Install metal panels for orientation, sizes, and locations as indicated on Drawings.

C. Install metal panels with proper anchorage and other components for this Work securely in place.

D. Install metal panels with provisions for thermal and structural movement.

E. Install shims to plumb substrates as necessary for installation of wall panels.

F. Install weather tight seals at perimeter of wall panel openings.
   1. Test for proper adhesion on small unexposed area of solid surfacing prior to use.
   2. Refer to Section 07 9200.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA - Architectural Sheet Metal Manual.
   1. Provide concealed fasteners where possible, and set units true to line and level as indicated.
   2. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   3. Install flashing and trim as wall panel Work proceeds.

H. Install weather tight escutcheons for pipe and conduit penetrating exterior walls.

I. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by wall panel manufacturer.

J. Install attachment system to support wall and soffit panels and with provisions to provide a complete weather tight wall system, including sub girts, extrusions, flashings and trim.
   1. Include attachment to supports and trims at locations using dissimilar materials.
   2. Do not apply sealants to joints, unless noted otherwise on Drawings or Shop Drawings.
   3. Install starter extrusion at base course and at cut panel locations.

K. Install accessories with positive anchorage to building and weather tight mounting and provisions for thermal expansion, and coordinate installation with flashings and other components.
   1. Install components required for a complete wall panel assembly including trim, copings, flashings and other accessory items.

L. Weather Barrier: Install weather barrier behind wall panels and over substrate in accordance with requirements of Section 07 2500.

3.04 TOLERANCES

A. Shim and align wall panel units with installed tolerances of 1/4 inch in 20 feet, non-cumulative, on level, plumb, and location lines as indicated.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation and in coordination with Mockup requirements, test area of assembly **as directed by Architect** for water penetration in accordance with AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Perform additional tests and inspections, at Contractor's expense, to verify compliance of replaced wall panels or necessary additional work with specified requirements.

F. Prepare test and inspection reports.

3.06 CLEANING

A. Upon completion of wall panel installation, clean finished surfaces as recommended by panel manufacturer.

B. Upon completion of wall panel installation, clear weep holes and drainage channels of obstructions and dirt.

3.07 PROTECTION

A. Protect installed products from damage during subsequent construction.

B. Replace metal panels damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 42 64 METAL COMPOSITE MATERIAL WALL PANEL

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.02 SUMMARY

A. Definition:

1. Metal Composite Material (MCM) System includes MCM, joints, attachment system components and miscellaneous materials as appropriate for the design of the project to provide a weather-resistant exterior cladding system.

B. Section Includes: MCM system installations

1. Applications of MCM system installations include:

a. Exterior installation and performance of MCM and MCM system components.

b. Interior installation and performance of MCM and MCM system components (if applicable).

C. Delegated Design

1. Design of the Metal Composite Material (MCM) system, including engineering of all support, anchorage, and attachment systems, is delegated to the Contractor in accordance with the requirements of Division 01 Section "Delegated Design Requirements

2. The Contractor shall engage a qualified professional engineer, licensed in the project jurisdiction, to prepare all design documentation, including calculations and shop drawings, demonstrating compliance with performance requirements.

D. Related Sections: Section(s) related to this section include:

1. Cold-Formed Metal Framing: Division 05, 05 40 00 Cold Formed Framing
2. Weather Barrier in Cavity Behind MCM: Division 07, 07 27 27 Fluid Applied Membrane air Barrier
3. Sheet Metal Flashing and Trim: Division 07, 07 62 00 Flashing and Trim
4. Joint Sealants: Division 07, 07 90 00 Joint Sealers
5. Glazing: Division 08, 08 44 13 Glazed Aluminum Curtain Walls

1.03 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed have either been identified by the International Building Code (IBC), local building code, or specific requirement for this building construction type.

B. Aluminum Association (AA)

1. Aluminum Design Manual
2. AA-M12C22A41: Anodized - Clear Coating
3. AA-M12C22A44: Anodized - Color Coating

C. American Society of Civil Engineers (ASCE)
   1. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM) International:
   1. ASTM D635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
   2. ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives
   3. ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics
   4. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
   5. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
   6. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference
   7. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Wall, and Doors By Uniform Static Air Pressure Difference
   8. ASTM E1233 Standard test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential

E. American Architectural Manufacturers Association (AAMA):
   1. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
   2. AAMA 501 Methods of Test for Exterior Walls

F. National Fire Protection Association (NFPA):
   1. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.04 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Delegated Design
   2. General Performance: Provide installed MCM system designed to withstand specified loadings while maintaining allowable deflection, thermal movement performance as defined by the Manufacturer, Fabricator, or Installer required by this section without defects, damage or failure

B. Deflection and Thermal Movement: Provide installed MCM systems that have been designed to resist to the wind loading, acting inward and outward, defined for this project:
   1. Perimeter Framing Deflection: Deflection of panel perimeter framing member shall not exceed L/175 normal to plane of the wall where L is the unsupported span of the perimeter framing member.
   2. Panel Deflection: Deflection of the panel face shall not exceed L/60 at design load where L is the unsupported span of the panel.
   3. Anchor Deflection: At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 0.0625 inch (1.6 mm).
   4. At 150% pressure, no permanent deformation exceeding L/1000 or failure to structural members is permitted.

5. Thermal Movements: Allow for free and noiseless horizontal and vertical thermal movement due to expansion and contraction of component parts over a temperature range of -20°F (-29°C) to +180°F (82.2°C) at the material surface.
    a. Buckling, opening of joints, undue stress on fasteners, failure of sealants, or any other detrimental effects of thermal movement will not be permitted.
    b. Fabrication, assembly and erection procedures shall take into account the ambient temperature range at the time of the respective operation.

C. System Requirements:
    1. Wet System – (Tested to AAMA 501 Standard)
        a. ASTM E283 – Air Leakage – Not more than 0.06 cfm per ft^2 of wall area (0.3 L/s▪m^2) when tested at 6.24 psf (300 Pa).
            b. ASTM E331 – Static Water Penetration – When tested under static pressure at 12.0 psf (575 Pa) minimum, for a time period of 15 minutes. MCM systems must have:
            i. No uncontrolled water leakage to the room side of the assembly when tested as defined by the procedure.
        c. AAMA 501.1 – Dynamic Water Penetration – When tested with a wall pressure equivalent to 12.0 psf (575 Pa) for a time period of 15 minutes, the MCM system must have:
            i. No uncontrolled water leakage to the room side of the assembly when tested as defined by the procedure.
        d. ASTM E330 – Structural Performance – MCM system must be engineered to meet the project design loads, however the MCM system must meet or exceed the following criteria when tested to a minimum pressure of 30.0 psf (1436 Pa):
            i. Deflections do not exceed limitations defined within the section on Deflection and Thermal Movement.

D. Fire Performance: Where required by governing code, provide fire retardant MCM that has been evaluated and is in compliance with code requirements specified herein.
    1. Fire Performance: Wall assemblies containing MCM System shall meet the requirements of the Intermediate Scale Multi-story test, NFPA 285, where required by code based for the design of this project.

1.05 SUBMITTALS

A. General: Provide submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.

B. Product Data: For each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of MCM System and accessory.

C. Shop Drawings: Submit shop drawings showing elevations and layouts, profiles, and product components, including anchorage, accessories, finish colors, and textures.
    1. Include details showing thickness and dimensions of the system parts, details of edge conditions, attachment system, corners, fastening and anchoring methods, locations of joints and gaskets, location and configuration of joints necessary to accommodate thermal movement, and all trim and flashings.
    2. Provide signed and sealed drawings by a qualified Design Professional licensed in the project jurisdiction, demonstrating conformance with the delegated design scope and the performance requirements identified for this project.

D. System Calculations: Submit MCM System Fabricator's complete system design and engineering

analysis/calculations including, but not limited to the following:

1. Show governing MCM types, mounting system including anchorages, connections, and fasteners. Indicate location, type magnitude, and direction of loads imposed on the building structural frame.
2. Analysis/Calculations shall be signed and sealed by a qualified Design Professional licensed in the project jurisdiction and shall demonstrate that the MCM system conforms to the delegated design scope and specified performance requirements.

E. Samples: Submit selection and verification samples for finishes, colors and textures

1. Selected Samples: Manufacturer's color charts or chips illustrating full range of colors, finishes and patterns available for MCM with factory applied finishes. Custom color selection requires color sample to be submitted for approval. Approval signatures are required by Architect.
    a) MCM System Fabricator shall not have filed for protection from creditors under state or federal insolvency or debtor relief statues or codes.
    b) MCM System Fabricator shall substantiate a track record of one of the Manufacturers listed in this specification working with the Fabricator/Installer for three (3) consecutive years and at a scale of operations cited above.
2. MCM System Installer Qualifications:
    a. The MCM System Installer shall have been in business under the present name for at least five (5) years prior to the start of this project and have experience with similar sized MCM system projects. The MCM System Installer must be capable of providing field service representation during construction.
    b. The MCM System Installer must be an approved installer by a MCA Certified Fabricator for the installation of their MCM System and have undergone proper training for the specified system thereof.

F. Regulatory Code Agencies Requirements: Provide MCM system which have been evaluated and are in compliance with the following, where required:

1. International Code Council (ICC)
2. Miami/Dade County Florida (Notice of Acceptance)
3. State of Florida (Florida Product Approval)

G. Mock-Ups: Install at project site a job mock-up using acceptable products and Fabricator approved details. Obtain Owner's and Architect's acceptance of finish color (draw down samples to be used for color approval of nonstandard coil coated colors), texture and pattern and workmanship standard. Comply with Division 01 Quality Control, 01 90 00, Mock-Up Requirements Section.

1. Mock-Up Size: To provide as detailed in the construction documents
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into final construction upon Architect's approval.
4. Provide Material required for custom color mock-ups at no cost to Owner. (consider special small quantity material runs may increase cost and require additional time to obtain material.

H. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and system Fabricator's installation details.

1.06 PROJECT CONDITIONS

A. Substrate Tolerances: The General Contractor is responsible for providing a substrate with a tolerance of 1/4 inch in 20.0 feet (6mm in 6m), on level, plumb, and location control lines as

indicated and within 1/8 inch (3mm) offset of adjoining faces of alignment of matching profiles tolerances are noncumulative.

B. Field Measurements: Verify locations of wall framing members and wall opening dimensions by field measurements prior the fabrication of the MCM System. Indicate measurements on the “As Built Shop Drawings”. Field measurements to be taken once all substrate materials and adjacent materials are installed.

C. Project Schedule: Provisions in the project schedule must accommodate the time interval between field measurements and fabrication/installation.

1.07 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. MCM Manufacturer’s Material Warranty: Submit, to the Owner, the manufacturer’s standard warranty.

1. Warranty Period:

a. MCM Material Integrity: Five (5) plus 1 years from date of Substantial Completion
b. MCM Painted Finish: Twenty (20) plus 1 years date of Substantial Completion.
c. MCM Natural Metal Surface: No finish warranty

C. MCM System and System Installation Warranty: Submit to the Owner, the MCM Fabricator system’s standard warranty document executed by authorized company official. The MCM system’s assembly warranty is in addition to and not a limitation of, other rights Owner may have under the Contract Documents.

1. Warranty Period

a. MCM System Workmanship: One (1) year warranty period commencing on Date of Substantial Completion.

b. Special Warranty: The MCM System Fabricator will repair or replace components of the MCM System that fails in materials or workmanship within the specified one (1) year warranty period above.

i. Failures include: deterioration of metals and other materials beyond normal weathering; structural failures including rupturing, cracking, puncturing, or loss of bond/adhesion characteristics.

PART 2 – PRODUCTS

2.01 METAL COMPOSITE MATERIAL (MCM) Manufacturers and Premium MCM System Fabricators

A. MCM Manufacturers:

1. Alpolic material manufactured by Mitsubishi Chemicals – www.alpolic-americas.com
2. Alucobond material manufactured by 3A Composites USA, Inc. – www.alucobondusa.com
3. larson material manufactured by Alucoil North America – www.alucoilnorthamerica.com
4. Reynobond material manufactured by Alcoa Architectural Products – www.reynobond.com

B. MCM System Fabricators:

1. Basis of Design: The Miller-Clapperton Partnership, Inc. – www.millerclapperton.com
2. Premium Certified MCM Fabricators recognized by the Metal Construction Association

2.02 METAL COMPOSITE MATERIAL (MCM

A. Material Description
   1. MCM Composition:
      a. Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or liquid adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products that are laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.
   2. MCM Thickness: 4mm (0.157 inch)
   3. MCM Face Sheets:
      a. Thickness: 0.5mm (0.02 inch) (nominal)
   4. MCM Product:
      a. Standard core material product acceptable for use:
         i. Less than 40 feet (12.2m) above grade in general accordance with the provisions of IBC Section 1407, or
         ii. Up to 50 feet (15.2m) above grade when used in general accordance with the specific provisions of IBC Section 1407.11.2 and complying with the performance requirements of ASTM D1929, or
         iii. Up to 75 feet (22.9m) above grade when used in general accordance with the specific provisions of IBC Section 1407.11.3 and complying with the performance requirements of ASTM D1929, ASTM D635 or
         iv. Up to 75 feet (22.9) above grade when used in general accordance with the specific provisions of IBC Section 1407.11.4 and complying with the performance requirements of ASTM D1929, ASTM D635 or
      b. Fire Retardant core material product acceptable for use:
         i. On Construction Type I, see drawings.
   5. Fire Performance: (Class A Material)
      a. ASTM E84: MCM shall have a flame spread index of not more than 25 when tested in the maximum thickness intended for use.
      b. ASTM E84: MCM shall have a smoke developed index of not more than 450 when tested in the maximum thickness intended for use.
   6. Bond Integrity: Tested for resistance to delamination as follows:
      a. Peel Strength (ASTM D1781): 22.5 in-lb/in (100 N-m/m) minimum as manufactured.
      b. No degradation in bond performance after 8 hours of submersion in water at 212°F (100°C) or 21 days of immersion in water at 70°F (21°C).
      c. Thermally bonded to the core material in a continuous process under heat, pressure, and tension.

2.03 FINISH

A. Exterior Finish: Finish shall meet the performance criteria of AAMA 2605.

B. All metal wall panels located within the natatorium and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

C. All metal wall panels located elsewhere in project shall receive Two-Coat Fluropolymer AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

D. No anodized Finish allowed within the natatorium and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure. These areas shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

E. Standard 2-coat and 3 coat finish:

   a. See drawings for color selections.

2.04 ACCESSORIES

A. General: Provide Fabricator’s standard MCM system accessories, including fasteners, clips, anchorage devices, and attachments for specific applications indicated on contract documents.

2.05 RELATED MATERIALS

A. General: Refer to other related sections in Related Sections paragraph specified herein for related materials, including cold-form metal framing, flashing and trim, joint sealants, aluminum windows, glass and glazing and curtain walls.

2.06 FABRICATION

A. General: Shop-fabricate panels to sizes and joint configurations indicated on drawings.

   1. Fabricate panels to dimensions indicated on drawings based on an assumed design temperature of 70°F (21°C). Allow for ambient temperature range at time of fabrication.
   2. Formed MCM panel lines, breaks and angles to be sharp and true, with surfaces that are free from warp or buckle.
   3. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.

B. Fabrication Tolerances: Shop-fabricate panels to sizes and joint configurations indicated on drawings.

   1. Width: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)
   2. Length: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)
   3. Squareness: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)

C. System Type

   1. Wet System
      a. The system must provide a wet seal (caulked) panel joint and must feature provisions to drain to the exterior face of the wall any leakage of water at joints and any condensation that may occur within the wall cavity as tested per AAMA 501. The sealant type shall be as specified in Section 07900 and with foamed type backer rod as indicated on architectural drawings.

D. Attachment System Components

   1. Formed from extruded aluminum as indicated on Contract Drawings to meet the specified design loads and system test performance according to each MCM System Fabricator’s design. Galvanized cold formed steel clips or staggered aluminum angles are not acceptable for panel to panel attachment.
   2. Panel stiffeners, as required, shall be positively engaged in the perimeter extrusion or mechanically fastened to the perimeter extrusion and *shall* be secured to the rear face of the

composite panel with silicone or high-strength double-sided bonding tape of sufficient size and strength to maintain panel's specified deflection under load. Structural calculations shall be provided to show the adequacy of this connection to resist the applied loads. Galvanized steel and MCM are not to be used as stiffener elements. Only panel stiffeners composed of extruded aluminum or 300 Series stainless steel shapes shall be adequate.

PART 3 – EXECUTION

3.01 MCM FABRICATOR/INSTALLER INSTRUCTIONS

Compliance: Comply with Manufacturer's product data, including product technical bulletins and product packaging instructions.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that conditions of substrates previously installed under other sections are acceptable for the MCM system installation. Documentation should be provided indicating any conditions detrimental to the performance of the MCM System.

3.03 PREPARATION

A. Miscellaneous Framing: Install miscellaneous MCM system support members and anchorage according to MCM System written instructions and drawings supplied by the MCM System Fabricator.

B. If required per project conditions, field measurements of the site condition are to be taken prior to beginning fabrication work and notification of any material modifications and resulting schedule adjustment shall be formally documented.

3.04 INSTALLATION

A. General:

1. Install the MCM system plumb, level and true in compliance with MCM System fabricator's recommendations.
2. Anchor the MCM system securely in place in accordance with Fabricator's approved shop drawings.
3. Comply with the MCM System Fabricator's instructions for installation of concealed fasteners and with provisions of Section 07 92 00 for installation of joint sealants.
4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet (6.4mm in 6.1m), noncumulative.
5. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts which require alteration to shop for modification, if possible, or for replacement with new parts.
6. Separate contact of dissimilar metals with bituminous paint, approved plastic shims, or other approved methods as defined within the Aluminum Design Manual (ASD). Use gasketed or approved coated fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

B. Related Products Installation Requirements: Refer to other sections in Related Sections paragraph herein for installation of related products.

3.05 FIELD QUALITY REQUIREMENTS

A. Field Quality Control: When required by contract, mock up shall be constructed and tested at the expense of the General Contractor, conduct water-spray test on the mock-up of the MCM System, testing for water penetration according to AAMA 501.2.

B. Testing Agency: the Owner shall engage a qualified testing agency top perform tests and inspections.

3.06 ADJUSTING and Cleaning

A. Adjusting:

1. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.
2. Removal of panels damaged by other trades shall be the responsibility of the General Contractor.
3. Repair components of the MCM system with minor damage such that repairs are not discernible at a distance of 10 feet (3m) from the surface at a 90° angle per AAMA 2605.
4. Remove and replace components of the MCM system damaged beyond repair.
5. Remove protective film immediately after installation of MCM and immediately prior to completion of the MCM system work. Masking intentionally left in place after panel installation on an elevation at the direction of the General Contractor, shall become the responsibility of the General Contractor.
6. Any additional protection, after installation, shall be the responsibility of the General Contractor.
7. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.
8. Remove from project site damaged MCM panels, protective film and other debris attributable to work of this section.

B. Cleaning:

1. Final cleaning shall not be part of the work of this section.

END OF SECTION

SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal soffit panels.

B. Delegated Design: Design of metal soffit panel system, including support framing, anchorage, fasteners, and verification of structural performance requirements and venting requirements.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference TBD

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

D. Delegated-Design Submittal: For metal soffit panels indicated to comply with delegated design requirements, including:
   1. Design calculations signed and sealed by a qualified professional engineer licensed in the jurisdiction of the Project.
   2. Analysis data to demonstrate compliance with performance requirements, including wind loads, deflection limits, and thermal movement.
   3. Details of panel anchorage, furring/support system, and interface with adjacent construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592 and per drawings:

1. Serviceability Requirements: No oil canning, vibration, or fluttering under design wind pressure.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 180 deg F (100 deg C) material surface variation.

E. Provide ventilation per SMACNA recommendations and guidelines for Soffit venting.

2.2 METAL SOFFIT PANELS

A. V-Groove-Profile Metal Soffit Panels.
1. Manufacturers and Products:
a. PAC-CLAD – Type H
i. V Groove

ii. 1” x 12”
iii. Flush wall panels
iv. Precision Series Box Rib with 1 Pencil Rib
v. Finish: From manufacturer’s full range of colors

B. Aluminum Plank Soffit Panels (Longboard):
1. Manufacturer: Longboard

2. Product Type:
a. Type F (Refer to Drawings)
b. V Groove Profile
c. Vented, Perforated Planks
d. Application: Exterior
e. Finish: From manufacturer’s full range of colors

3. Material: Extruded aluminum alloy 6063 T5 or T6.

4. Finish: AAMA 2605-compliant powder coating or anodized finish.

5. Panel Dimensions: As indicated on drawings or approved shop drawings.

6. Mounting: Use manufacturer’s proprietary concealed fastener system.

2.3 ACCESSORIES

A. Provide factory-formed flashings, trim, and accessories required for complete installation.

B. Fasteners: Corrosion-resistant, self-tapping stainless steel screws with EPDM washers, concealed where possible.

C. Sealants: As recommended by panel manufacturer, compatible with panel materials and adjacent substrates.

2.4 UNDERLAYMENT

A. Self-adhering, high-temperature modified bituminous membrane, minimum 40 mils thick and as required for this location.

B. Compliant with ASTM D1970.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 METAL PANEL INSTALLATION

A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

E. Coordinate with adjacent materials i.e. curtain walls, soffit vents and seatlant joints.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074293

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
2. Roof insulation.
3. Cover board.
4. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking, and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
5. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site .

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing or other approved testing showing compliance with IBC Code.
2. Provide information indicating sole sourcing. If other manufacturer’s and products are acceptable to roofing manufacturer as part of their warranted system include such materials and data with product submittal along with manufacturer’s written acceptance letter stating material use is acceptable and does not affect performance and warranty.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
5. Crickets, saddles, and tapered edge strips, including slopes.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations. Confirm patterns as listed in Part 3 and modify as required by manufacturer and installation method for project conditions and wind loads indicated for Project in coordination with applicable codes and design requirement indicated in structural drawings.
7. Tie-in with adjoining air barrier.
8. Provide “End of Day’s work” or “night” seal details to show how section of roof work are to be sealed from moisture infiltration to completed areas.

C. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer .

B. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Evaluation Reports: For components of membrane roofing system, from ICC-ES.

D. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. If a subcontractor is utilized for installation, the subcontracted installer must possess manufacturer's certification.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
   a. Warranty shall be considered "edge-to-edge" inclusive of all trim and accessories.
2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746/D 3746M, ASTM D 4272/D 4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): Per Structural; or as engineered by roofing manufacturer for the project conditions .
2. Zone 2 (Roof Area Perimeter): Per Structural; or as engineered by roofing manufacturer for the project conditions .
   a. Location: From roof edge to Specified dimensions inside roof edge.
3. Zone 3 (Roof Area Corners): Per Structural; or as engineered by roofing manufacturer for the project conditions .
   a. Location: Specified dimensions in each direction from each building corner.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

B. Subject to compliance with the project requirements, provide products by one of the following:

1. Johns Manville

2. Soprema

2.3 BASE SHEET MATERIALS

A. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D 6164/D 6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for cold adhesive application method.

2.4 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET

A. Granule-Surfaced Roofing Cap Sheet: ASTM D 6164/D 6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White .

2.5 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 4601/D 4601M, Type I , asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Granule-Surfaced Flashing Sheet: ASTM D 6164/D 6164M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric , granule surfaced, suitable for application method specified, and as follows:

1. Granule Color: White .

C. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.6 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Roof Vents: As recommended by roof membrane manufacturer.

1. Size: Not less than4-inch diameter.

D. Sheathing Paper (for wood decks): Red-rosin type, minimum 3 lb/100 sq. ft..

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required by roofing system manufacturer for application.

G. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

H. Fasteners: Factory-coated steel fasteners and metal insulation plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

I. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve; color to match roof membrane.

J. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

K. Roofing Membrane Adhesive: SBS modified bitumen membrane adhesive for use with sanded base ply and granule surfaced cap sheet membranes. Manufacturer's approved membrane adhesive meeting or exceeding ASTM D3019 Type III. VOC Content 250 g/L or less/.

L. Asphalt Primer: Manufacturer's approved asphalt primer meeting ASTM D41 Type I.

2.7 SUBSTRATE/COVER BOARDS

A. Cover Board: Mineral-fortified asphaltic core reinforced with asphalt-saturated glass mat.

1. Products: Subject to compliance with the project requirements, provide:
   a. Soprema: Sopraboard - 1/4"
   b. IKO
   c. Blue Ridge

2.8 ROOF INSULATION

A. General: Preformed roof insulation boards, manufactured or approved by roof membrane manufacturer,.

B. Polyisocyanurate Board Insulation: ASTM C 1289 Type II Class I, felt or glass-fiber mat facer on both major surfaces.

1. Thickness:
   a. 4-1/2 inches minimum unless otherwise indicated on drawings. Provide in multiple layers, staggered in largest size permissible. 2.5" Base Layer with 2" Top Layer.

C. Tapered Crickets: Provide factory-tapered insulation boards.

1. Material: Match roof insulation .
2. Minimum Thickness: 1/2 inch.
3. Slope:
   a. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.9 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry."

1. Note: The owner will not accept expanded "Perlite" insulation or similar eave or tapered insulation or cants. All cants shall be treated wood. All tapered board shall be polyiso.

2.10 WALKWAYS

A. Walkway Cap-Sheet Strips: ASTM D 6164/D 6164M, Type I or II, Grade G, SBS-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); granule surfaced; suitable for application method specified, and as follows:

1. Size: 36 by 60 inches .
2. Granule Color: White .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
5. Provide information in daily field reports that checks and documents moisture content of the roofing substrate. Preferable method is by RH probe. Plastic sheet method or electronic concrete meter may also be used for this Project.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.

1. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSULATION AND COVER BOARD INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F.

1. Note: The owner will not accept Perlite or similar expanded board/cellulose insulation cants. All cants shall be treated wood.

D. Installation Over Metal Decking:

1. Fasten base layer, top layer, Crickets and cover board to deck specified insulation fasteners and plates. Evenly distribute fasteners as required by the board manufacturer’s published requirements.
2. Fasten insulation to meet specified wind uplift pressure requirements and warranty requirements.
3. Minimum Fastening requirement: Coordinate fastening patterns with Part 1 and modify as needed.
    1. Field Zone 1 16 fasteners per 4x8 board
    2. Field Zone 1 16 fasteners per 4x8 board
    3. Perimeter Zone 2 24 fasteners per 4x8 board
    4. Corner Zone 3 32 fasteners per 4x8 board

4. For insulation/cover board located partially within the defined perimeter and or corners, nstall fastening for the entire board as specified herein.

3.5 INSULATION AND COVER BOARD SYSTEM APPLICATION

A. Follow insulation system component product data sheets, published general requirements and approvals.

B. Install all insulation system components on clean, dry, uniform, and properly prepared substrates.

C. All Insulation system boards shall be carefully installed and fitted against adjoining sheets to form tight joints.

D. Insulation system boards that must be cut to fit shall be saw cut or knife cut in a straight line, not broken. Chalk lines shall be used to cut insulation components. Uneven or broken edges shall not be accepted. Remove dust and debris that develops during cutting operations.

E. Stagger successive layers of insulation 12 in vertically and laterally to ensure board joints do not coincide with joints from the layers above and below.

F. Crickets, saddles, and tapered edge strips shall be installed before installing cover boards.

G. Install tapered insulation, saddles, and crickets as required to ensure positive slope for complete roof drainage.

H. Cover boards shall be installed to fit tight against adjacent boards. When required by the cover board manufacturer a uniform gap shall be provided between cover boards using a uniform guide placed between board joints to form a gap between all boards during installation.

I. The finished insulation system surface shall be tight to, and flush with, adjacent substrates to form a satisfactory substrate to install specified roof membrane and flashings.

J. Install specified cants where required for membrane flashing transitions.

3.6 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Where roof slope exceeds 1/2 inch per 12 inches , install roofing membrane sheets parallel with slope.

D. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.

2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.7 MEMBRANE ADHESIVE APPLICATION

A. The ambient temperature shall be above 50 degrees and the adhesive temperature shall be a minimum of 70 degrees at the point of membrane application.

B. To ensure the adhesive is applied at 70 degrees during cold weather drums and 5 gallon pails shall be stored in heated areas. Drums and 5 gallon pails exposed to cold temperature on the roof shall be provided with heaters when necessary to ensure the minimum application temperature is maintained.

C. Priming substrates is optional when solvent based membrane adhesives are used. Primer may be applied to reduce adhesive consumption rates for some absorptive surfaces.

D. Membrane adhesive shall be applied using 3/16 – 3/8 inch notched squeegee, brush, or spray equipment.

E. Apply adhesive to clean, dry, and prepared compatible substrates as required to ensure full adhesion.

F. Follow the adhesive product data sheet requirements for application rates.

G. Apply a uniform application of membrane adhesive at the application rate published by the product data sheet.

H. Apply 1-1/2 – 2-1/2 gallons per square between membrane plies. The application rate is 3 to 4 gallons per square over absorptive substrates and over granule surfaces. Refer to manufacturer's product data sheet and adjust application rate based upon surface conditions.

I. Install SBS membrane ply before the adhesive begins to skim over. Once adhesive skims over, the membrane ply will not adhere.

3.8 SBS-MODIFIED COLD ADHESIVE MEMBRANE INSTALLATION

A. Follow material product data sheets and published general requirements for installation instructions.

B. Ensure environmental conditions are satisfactory and will remain satisfactory during the application o the membrane adhesive and membrane plies.

C. Unroll membrane onto the roof surface and allow the membrane to relax prior to installing the membrane.

D. Re-roll the membrane in order for the plies to be rolled into the adhesive while ensuring the specified side and end laps are maintained.

E. Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back water laps.

F. Cut rolls to working lengths and widths to conform to roof conditions and lay out to always work to a selvage edge.

G. Ensure all roofing and flashing substrates are prepared as necessary, and all substrates are acceptable to receive the specified adhesive and membrane.

H. Install the specified membrane adhesive ahead of the membrane application. Do not allow the adhesive to skim over before the membrane is applied into the adhesive. The membrane will not adhere where the adhesive has skimmed over.

I. Where laps are adhered using membrane adhesive, apply sufficient adhesive coverage to ensure 1/8 to ¼ inch bleedout is present at all laps.

J. Once set in place, ensure specified side-laps and end-laps are maintained.

K. At the end laps cut a 45 degree dog ear away from the selvage edge for all T-joints.

L. For low slope areas ¼ inch per foot, or where otherwise specified/required leave all membrane side and end laps dry to hot air weld or torch all laps water-tight. Embed granules, where present, when heat welding sheets.

M. Use a follow tool, weighted roller or broom the leading edge of the membrane to the substrate, working forward and outward as necessary to remove wrinkles. Avoid walking over the membrane during application.

N. Each day, physically inspect all side and end laps and ensure the membrane is sealed water-tight. Where necessary use a torch or hot air welder and a clean trowel to ensure all laps are fully sealed.

O. Inspect the installation each day to ensure the plies are fully adhered. Repair all voids, wrinkles, open laps, and all other deficiencies.

P. Offset the cap sheet side and end laps away from the base ply laps so that cap sheet laps are not located within 18 inches of the base ply laps.

Q. Immediately broadcast matching granules into adhesive bleed-out at cap sheet laps or otherwise treat bitumen bleed-out once adhesive has dried and cured.

3.9 FLASHING APPLICATION HEAT WELDED

A. Refer to SBS manufacturer’s membrane application instructions, flashing detail drawings, and follow product data sheets and other published requirements for installation instructions. Refer to manufacturer’s membrane flashing detail drawings.

B. The contractor is responsible for project safety. Refer to NRCA CERTA recommendations and building owner requirements for hot work operations.

C. Where required to seal substrates for fire safety, install specified adhered, self-adhered or fastened backer ply to the substrate. Ensure backer-ply covers and seals all substrates requiring protection from exposure to torch operations.

D. Ensure all flashing substrates that require primer are primed, and the primer is fully dry.

E. Unroll the flashing base ply and flashing cap sheet onto the roof surface to their complete length. Once relaxed, cut the membrane to the required working lengths to accommodate the flashing height, cants, and the required over-lap onto the horizontal roof surface.

F. Cut the flashing membrane from the end of the roll to always install flashings to the side-lap line or selvage edge line.

G. Lay out the flashing base ply and flashing Cap Sheet to offset all side-laps a minimum of 12 inches so that side-laps are never aligned on top of the ply beneath. Shingle the flashing ply laps to prevent back-water laps.

H. Install non-combustible cant strips at transitions where required.

I. Ensure correct membrane and flashing sequencing to achieve redundant, multi-ply, watertight flashings.

J. ROOF MEMBRANE BASE PLY:

1. Before installing flashings, install the roof membrane base ply in the horizontal field of the roof, and extend the base ply up to the top of the cant, where present, at roof terminations, transitions, and penetrations.

K. FLASHING BASE PLY:

1. Install the flashing base ply starting at the top leading edge of the vertical flashing substrate, down over the cant and onto the horizontal surface of the roof a minimum of 3 inches beyond the of base of the cant onto the roof. Cut the base ply at corners to form 3-inch side-laps. Install gussets to seal corner transitions.
2. Install one or more flashing base ply(s) at all roof terminations, transitions, and penetrations.

L. ROOF MEMBRANE CAP SHEET:

1. Install the roof membrane Cap Sheet in the horizontal field of the roof over the flashing base ply up to the roof termination, transition, or penetration, and up to the top of cants where present.
2. Using a chalk line, mark a line on the membrane cap sheet a minimum of 4 inches from the base of the cant onto the roof. Where granules are present, embed the cap sheet granules using a torch and trowel or granule embedder to prepare the surface to receive the flashing cap sheet.

M. FLASHING CAP SHEET:

1. Install the flashing Cap Sheet starting at the top leading edge on the vertical substrate, over the cant and onto the roof surface 4 inches from the base of the cant onto the roof.

2. Install the flashing Cap Sheet to ensure a minimum two (2) ply flashing system is present at all roof terminations, transitions, and penetrations.

N. During the membrane and flashing installation, ensure all plies are completely adhered into place, with no bridging, voids, or openings. Ensure bitumen or flashing cement bleed-out is present at all flashing side and end-laps.

O. Use a damp sponge float or damp rag to press-in the heat-welded flashing plies during installation.

P. Where sufficient bitumen bleed-out is not present, and for all self-adhered plies, apply specified gun-grade sealant or mastic to seal the membrane termination along all roof terminations, transitions, and penetrations. These include gravel stop edge metal, pipe penetrations, along the top edge of curb and wall flashing, and all other flashing terminations where necessary to seal flashings watertight.

Q. Fasten the top leading edge of the flashing 8 in on-centers with appropriate 1 in metal cap nails or other specified fasteners and plates. Seal fastener penetrations watertight using specified sealant or mastic.

R. Manufacturer's liquid-applied, reinforced flashing systems shall be installed where conditions are not favorable to install SBS modified bitumen flashings. Such conditions include irregular shapes penetrating roof surfaces (I-beams), confined areas and low flashing heights. Manufacturer's liquid-applied, reinforced flashing systems are recommended in lieu of pitch pans and lead pipe flashings.

3.10 WALKWAY INSTALLATION

A. Walkway Cap Sheet Strips: Install walkway cap sheet strips over roofing membrane, using same application method as used for roofing cap sheet.

1. Install walkways strips at the following locations:
   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Top and bottom of each roof access ladder.
   e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
   f. Locations indicated on Drawings.
   g. As required by roof membrane manufacturer's warranty requirements.
2. Provide 3-inch clearance between adjoining strips.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests: REVISION 1 - ASI #4 - 09-25-2024 Perform one of the following tests noted in items 3 or 4 below to determine if there are any moisture issues or leaks. Before performing such testing provide costs associated with each test to the Owner and gain Owner direction in writing prior to engaging and performing such testing.

1. Visually inspect roofing system by walking roof after any rain events during construction and after completion of an individual roof area to verify that there is no ponding. Note any such areas by photograph and written notes and diagrams and repair to eliminate such ponding.
2. Infrared Thermography: Testing agency shall survey entire roof area using infrared color thermography according to ASTM C 1153.
    a. Perform tests before overlying construction is placed.
    b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing, or by nuclear hydrogen detection testing.
    c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
        1) Cost of retesting is Contractor's responsibility.
    d. Testing agency shall prepare survey report of initial scan indicating locations of entrapped moisture if any.
3. Electrical Capacitance/Impedance Testing: Testing agency shall survey entire roof area for entrapped water within roof assembly according to ASTM D 7954/D 7954M.
    a. Perform tests before overlying construction is placed.
    b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
        1) Cost of retesting is Contractor's responsibility.
    c. Testing agency shall prepare survey report indicating locations of entrapped moisture, if any.
4. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

C. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

1. Determine approximate quantities of components within roofing membrane according to ASTM D 3617/D 3617M.
2. Examine test specimens for interply voids according to ASTM D 3617/D 3617M and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

F. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Formed steep-slope roof sheet metal fabrications.
4. Formed equipment support flashing.
5. Formed overhead-piping safety pans.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
3. Section 079500 "Expansion Control" for manufactured sheet metal expansion-joint covers.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
2. Provide test data indicating compliance with SPRI ES-1, RE1, RE2, and RE3, as applicable to the Project, for uplift resistance criteria of edge metal(s) meeting conditions of the Project. May be indicated in separate product information submittal or indicated in Shop Drawings.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.
13. Include test data indicating compliance with SPRI ES-1, RE1, RE2, and RE3 as applicable to the Project, for uplift resistance crieterir of edge metal(s) meeting conditions of the Project.

C. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 incheslong by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 incheslong and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.
2. SPRI ES-1 tests RE 2 and RE-3.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).

C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat.

2. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inchwide and 1/8 inchthick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. High-Temperature Self-Adhered Membrane Flashings.

1. Where required in the drawings for use under metal copings, metal panels and other sheet metal flashings subject to direct sunlight and/or high temperatures provide 40 mil thick product capable of handling such high temperatures. With product provide data indicating product is acceptable for use for such areas and compatible with substrate it is being applied to.
   a. Atlas WeatherMaster Pro-Grade Ice and Water Underlayment.
   b. Grace Ice and Water Shield HT.
   c. Other approved equal.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feeton slope and location lines indicated on Drawings and within 1/8-inchoffset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inchdeep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

F. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock

gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

1. Gutter Profile: Style A according to cited sheet metal standard.
2. Expansion Joints: Butt type with cover plate.
3. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.
4. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
    a. Galvanized Steel: 0.022 inch thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: Fig 1-35A according to SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:
    a. Galvanized Steel: 0.022 inch thick.

C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

E. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Stainless Steel: 0.019 inch thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate from the Following Materials:
    a. Galvanized Steel: 0.028 inch thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of

external leg and drill elongated holes for fasteners on interior leg. Miter corners (welded or continuous one piece fabrication), fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate from the Following Materials:
   a. Galvanized Steel: 0.040 inch thick.

C. Roof Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.

1. Galvanized Steel: 0.034 inch thick.

D. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

H. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Valley Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

C. Drip Edges: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Galvanized Steel: 0.040 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inchesapart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inchesof corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inchdeep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inchinto sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in zinc where necessary for strength.

3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous cleat.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
4. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
6. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with 1-1/2-inchtelescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 incheso.c.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system.

D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.

E. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

F. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inchbelow scupper discharge.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers or as otherwise required to comply with ANSI/SPRI/ES-1 for the design conditions indicated.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

1. Anchor interior leg of coping with washers and screw continuous cleat(s) anchored to substrate fasteners as required to comply with ANSI/SPRI/ES-1 for the design conditions indicated.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inchesover base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inchesover base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feeton slope and location lines indicated on Drawings and within 1/8-inchoffset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured roof specialties, including copings, fascias, and penetration flashing.

1.2 RELATED REQUIREMENTS

A. Section 07 52 16 Styrene-Butadiene - Styrene (SBS Modified Bituminous Membrane Roofing

B. Section 07 62 00 - Sheet Metal Flashing and Trim

C. Section 07 72 00 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

D. Section 07 90 00- Joint Sealers.

1.3 REFERENCE STANDARDS

A. ANSI/SPRI/FM 4435/ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011.

B. NRCA (RM) - The NRCA Roofing Manual; 2017.

C. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Specialty Penetration Flashings:
   1. York Manufacturing, Inc.: www.yorkmfg.com.
   2. Roof Products & Systems Corp.: www.rpscurbs.com.
   3. Portals Plus, Inc.: www.portalsplus.com.
   4. Pate Company: www.patecurbs.com.

2.2 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable code.

B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.

1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 RE-3 to positive and negative design wind pressure as defined by applicable code.

C. Control and Expantion Joint Covers: Composite construction of flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 5 inches. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

D. Specialty Penetration Flashings: Preformed EPDM pipe and penetration seals designed for waterproof seal of individual, and clustered, roof penetrations.
1. Provide size and configuration required by each specific condition to provide maximum height above roof surface to the stainless steel clamping ring.
2. Where a preformed flashing boot will not slide over a penetrating item, provide "Retrofit Flashing" by Portals Plus Inc. designed to wrap around the item and closed with a weatherproof seal.
3. Where a metal base is required by the roofing membrane manufacturer for tie-in to the roof membrane, provide one of the following:
   a. Alumi-Flash System manufactured by Portals Plus Inc.
   b. Alumi Flash manufactured by Roof Products & Systems Corp.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

C. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

D. Provide weathertight installation.

END OF SECTION

SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-finished aluminum gutters and downspouts.

B. Precast concrete splash pads.

1.2 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Conform to SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.

B. Conform to applicable code for size and method of rain water discharge.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures

B. Product Data: Provide data on prefabricated components.

C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

D. Samples: Submit two samples, 12 inch long illustrating component design, finish, color, and configuration.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209 (ASTM B209M); 0.032 inch thick.

1. Finish: Plain, shop pre-coated with modified silicone coating.
2. Color: To match Architect's sample.

2.2 COMPONENTS

A. Gutters: SMACNA rectangular style profile.

B. Downspouts: SMACNA Rectangular profile.

C. Anchors and Supports: Profiled to suit gutters and downspouts.
   1. Anchoring Devices: In accordance with SMACNA requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

D. Fasteners: Galvanized steel, with soft neoprene washers.

2.3 ACCESSORIES

A. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

2.4 FABRICATION

A. Form gutters and downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.5 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; custom color to match approved sample.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that surfaces are ready to receive work.

3.2 PREPARATION

A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.

C. Slope gutters 1 unit in 96 units along entire length.

D. Set splash pans under downspouts.

END OF SECTION

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof hatches, manual and automatic operation, including smoke vents.

1.2 RELATED REQUIREMENTS

A. Section 07 52 00 - Modified Bituminous Membrane Roofing.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashing.

C. Section 09 96 00 High Performance Coatings

D. Division 26 - Electrical: Fire alarm interconnection.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Guarding floor and wall openings and holes; current edition.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

E. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2015.

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

B. Lifeline Design Data: Two copies of comprehensive design calculations for lifeline, connection and anchorage devices. Review of design calculations shall not alter manufacturer's design responsibility for system and connectors.

C. Manufacturer's Certification: Certify that walkway and railings have been designed to meet the design criteria of the specified code; include all conditions or limitations of the design necessary to achieve the necessary strength for the loading specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS - LIFELINE

A. Design, engineer, construct and load-test system.

B. Provide supports, and anchors designed and constructed to suit building configuration and in accordance with the contract documents and applicable regulations and codes.

C. Design all anchor components to provide adequate attachment to building and to suit current maintenance practices; ensure compatibility with industry standard equipment.

D. Design calculations performed and certified by a professional engineer licensed in the State where the project is located for structural adequacy of system. Coordinate structural calculations with submittals.

2.2 PERFORMANCE REQUIREMENTS - LIFELINE

A. Safety Factor: Design primary support equipment to sustain without failure at least four times the maximum static working load applied or transmitted to the components. In no case shall the combined live and dead loads be calculated at less than 1000 pounds.

B. Base plates and sockets: Total safety factor of 4 to 1 against the overturning moment through 360-degree rotation.

C. Wire rope rated capacity: To resist the combined live and dead load with a factor of safety of 6 to 1 against yield.

D. Fall Arrest Safety Anchors: Designed to a maximum fall arresting force of typically 1800 lbs. when wearing a body harness with a safety factor of 2 without any permanent deformation and to 5000 lbs. against fracture or detachment.

2.3 ROOF HATCHES

A. Manufacturers - Roof Hatches:
   1. Bilco Company; Type F (equipment access, 4 ft square): www.bilco.com.
   2. Milcor by Commercial Products Group of Hart & Cooley, Inc; Model RD-4x4 EE: www.milcorinc.com.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Roof Hatches and Smoke Vents, General: Factory-assembled steel frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. Mounting: Provide frames and curbs suitable for mounting on flat roof deck.
   3. For Ships Ladder Access: Single leaf; 48 by 48 inches.

C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gage, 0.0907 inch thick.
   2. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
   3. Curb Height: 12 inches from finished surface of roof, minimum.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Mill finished aluminum; outer cover 11 gage, 0.0907 inch thick, liner 0.04 inch thick.

3. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
4. Gasket: Neoprene, continuous around cover perimeter.

E. Ladder Safety Post: Tubular steel telescopic post that automatically locks when fully extended through hatchway. Stainless steel spring balancing mechanism to provide controlled upward and downward operation. Release lever to disengage the post to allow return to lowered position. Adjustable mounting brackets to fit ladder rung spacing up to 14-inches on center; clamp brackets to accommodate ladder rungs up to 1-3/4-inch in diameter.

F. Safety Railing System: Manufacturer's standard accessory safety rail system mounted directly to curb.
1. Comply with 29 CFR 1910.23, with a safety factor of two.
2. Posts and Rails: Aluminum tube.
3. Finish: Manufacturer's standard, factory applied finish.
4. Manufacturers:
a. Bilco Company: www.bilco.com/sle.

G. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
2. Hinges: Manufacturer’s recommended type.
3. Hold open arm with vinyl-coated handle for manual release.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior.
6. Locking: Padlock hasp on interior.
7. All hardware to be stainless steel

2.4 HORIZONTAL CABLE LIFELINES

A. Manufacturers:
1. Pro-Bel Group: www.pro-bel.ca.
2. Guardian Fall Protection: www.guardianfall.com.
3. Capital Safety: www.capitalsafety.com.
4. XS Platforms: www.xsplatforms.com.
5. 01 25 00 Substitution Procedures and Substituion Request Form

B. Horizontal Lifeline System: Hands-free cable type.
1. Cable: 5/16 inch or 1/2 inch diameter Type 316 stainless steel with minimum breaking strength of 19,125 pounds, complete with permanently swedged cable ends.
2. Data Plate: At cable system entry points, provide prominently displayed non-corrodible data plate clearly stating Maximum Service Capacity and Number of Users.
3. Intermediate Support Brackets: Multi-position Type 316 stainless steel secured using 1/2 inch diameter fasteners.
4. Entry/Exit Brackets: Type 316 stainless steel.
5. Connector: Type 316 stainless steel, with automatic connector bypass feature for continuous hands-free operation, and detachability feature for window cleaning operations.
6. Tensioner Units: Type 316 stainless steel with polished finish.
7. Harness: Manufacturer's standard hands-free full body harness and lanyard complete with shock absorber.
8. Accessories: Manufacturers standard corner units as required.
9. Product: Hands-Free Horizontal Lifeline System manufactured by Pro-Bel Group: www.pro-bel.ca

C. Roof Anchors:
1. Safety and Tie-Back Anchors: U-bar type; ASTM A666 Type 304 stainless steel with yield strength of 36 Ksi, of not less than 3/4 inch diameter material with 1-1/2 inch eye opening.

2. Piers: ASTM A500/A500M seamless round steel tubing with yield strength of 50 Ksi, hot dipped galvanized to ASTM A123/A123M, with wall thickness to suit application.
3. Base Plates and Other Sections: ASTM A572/A572M galvanized mild steel as above with yield strength of 44 Ksi. Thickness and securement to suit application.
4. Miscellaneous Bolts, Nuts and Washers: ASTM A307 with yield strength of 44 Ksi, hot dipped galvanized to ASTM A123/A123M or Type 304 stainless steel with yield strength of 35 Ksi.
5. Flashing for Roof Mounted Supports and Anchors in Bituminous Roofing: Seamless spun aluminum flashing, ASTM B221, Type 6061-T6 alloy with deck flange flashed in to NRCA ML104 recommendations.
6. Product: Roof Anchors manufactured by Pro-Bel Group: www.pro-bel.ca

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Supply items required to be cast into concrete with setting templates, to appropriate Sections.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

B. Coordinate with installation of roofing system and related flashings.

C. Apply bituminous paint on metal surfaces of roof hatches to be in contact with cementitious materials and dissimilar metals.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 76 13 - ROOF PAVERS AND BALLAST MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pavers for roofing ballast.

1.2 RELATED REQUIREMENTS

A. Section 07 52 00 - Modified Bituminous Membrane Roofing.

1.3 REFERENCE STANDARDS

A. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.

B. ASTM C293/C293M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading); 2016.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Selection Samples: Two complete sets of color chips representing manufacturer's full range of colors and patterns available from regional plant.

C. Verification Samples: Two samples, minimum size 12 inches square, representing actual product to be supplied from regional plant, color, and patterns.

D. Specimen warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging, with labels intact, until ready for installation.

B. Store products off the ground; if stored on the roof, do not exceed structural capacity of deck.

1.6 WARRANTY

A. See Section 01 77 00 - Closeout Proceduresfor additional warranty requirements.

B. Ballast Pavers: Provide manufacturer's 20-year limited material warranty.

C. Ballast Pavers: Provide manufacturer's limited wind uplift warranty for 3 years after Substantial Completion.

1.7 MAINTENANCE TOOLS

A. Paver Lifter: Provide one Probst Slab Grabber; deliver to Owner at location directed; provide 3-year warranty.

PART 2 PRODUCTS

2.1 ROOF DECK APPLICATIONS (OCCASIONAL FOOT TRAFFIC ONLY)

A. Ballast Pavers: Precast concrete units with integral color and tooled joint pattern.
   1. Basis of Design: Tectura Lok Down pedestal system manufactured by Wausau Tile, Inc.
   2. Products:
      a. Pavers on Pedestals manufactured by Hanover Architectural Products: www.hanoverpavers.com.
      b. Roofblok Ballast Systems manufactured by Roofscape Architectural Pavers: www.roofblok.com.
   3. Size:
      a. 24 by 48 inches
      b. 30 by 30 inches
   4. Thickness: 2-3/4 inches.
   5. Compressive Strength: 7000 psi, minimum, air entrained mix, after 28 days cure, when tested in accordance with ASTM C140/C140M.
   6. Flexural Strength: 400 psi, when tested in accordance with ASTM C293/C293M.
   7. Density: 145 pcf, maximum.
   8. Water Absorption: 5 percent (nominal), when tested in accordance with ASTM C140/C140M.
   9. Color: As selected.

B. Protection Mat: Nonwoven polyester.

C. Mechanical Clips: Galvanized sheet metal.

D. Adjustable Height Paver Pedestals: High impact styrene adjustable paver pedestals telescope from 2 inch to 5-1/2 inch, tilt to accommodate sub-surface slope and create a smooth, uniform, paver surface.
   1. Provide sizes and height required to make top surface of pavers a single plane without abrupt changes in surface plane.
   2. Product: Terra-Tab manufactured by Tectura Designs0

E. Perimeter Attachments: Products made by one of the following:
   1. Metal Era: www.metalera.com.
   2. W.P. Hickman: www.wphickman.com.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until all roofing or waterproofing work is completed, including work penetrating waterproof plane.

3.2 PREPARATION

A. Clean roof surfaces thoroughly prior to installation.

B. Plan sequence of transporting and placing pavers to avoid damage to waterproof membrane and already installed pavers; place 3/4 inch thick plywood in traffic paths or use carts with pneumatic tires.

3.3 ROOF BALLAST

A. Install pavers on paver pedestals in accordance with manufacturer's instructions. Provide approximately 1/4 inch space between pavers to permit surface water drainage.

B. Install pavers in locations and pattern indicated on drawings.

C. Install protection mat wherever required by roof membrane manufacturer.

D. Install perimeter retainer around entire perimeter.

3.4 PROTECTION

A. Protect installed products until completion of project. Prohibit construction traffic unless adequate precautions are taken.

B. Repair or replace products damaged due to inadequate protection.

END OF SECTION

SECTION 07 81 00 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Concealed SFRM.
   2. Exposed SFRM.
   3. Exposed intumescent mastic fire-resistive coatings.

B. Related Sections include the following:
   1. Division 05 Section "Structural Steel Framing" for surface conditions required for structural steel receiving SFRM.
   2. Division 07 Section "Thermal Insulation" for fire-safing insulation.
   3. Division 07 Section "Penetration Firestopping" for fire-resistance-rated firestopping systems.
   4. Division 07 Section "Fire-Resistive Joint Systems" for fire-resistance-rated joint systems.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive material.

B. Concealed: Fire-resistive materials applied to surfaces that are concealed from view behind other construction when the Work is completed and have not been defined as exposed.

C. Exposed: Fire-resistive materials applied to surfaces that are exposed to view when the Work is completed, and that are identified as exposed on Drawings.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design SFRM thickness and application according to the hour ratings listed in Schedule, performance requirements and design criteria indicated, including comprehensive engineering analysis by a qualified professional engineer.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Structural framing plans indicating the following:
   1. Locations and types of surface preparations required before applying SFRM. Include locations for Architect’s review and approval of all locations receiving Level 3 finish as described below, 2.3 1, a.
   2. Extent of SFRM for each construction and fire-resistance rating, including the following:

      a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.

For steel joist assemblies, include applicable fire-resistance design designations, with each steel joist tested with the same maximum tensile stress as each steel joist indicated. Design designations with steel joists tested at lower maximum tensile stress than those indicated are not permitted.

b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

3. Treatment of SFRM after application.

C. Samples for Initial Selection: For each type of colored, exposed SFRM indicated.

D. Delegated Design Submittal: For installed SFRM indicated to comply with performance requirements, and design criteria including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. SFRM Schedule: Tabulated schedule of SFRM with information including, but not limited to, application areas, surface finish for exposed, and color.

F. Samples for Verification: For each type of colored, exposed SFRM, two Samples, each 4 inches square, of each color, texture, and material formulation to be applied. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

G. Product Certificates: For each type of SFRM, signed by product manufacturer.

H. Qualification Data: For Installer, manufacturer, professional engineer, and testing agency.

I. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating the following:
1. Materials have been tested for bond with substrates.
2. Materials have been verified by SFRM manufacturer to be compatible with substrate primers and coatings.
3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

J. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed SFRM.

K. Research/Evaluation Reports: For SFRM.

L. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by SFRM manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Source Limitations: Obtain SFRM through one source from a single manufacturer.

C. SFRM Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
1. SFRMs are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Testing is performed on specimens of SFRMs that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.

3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

D. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with SFRM.

E. Fire-Test-Response Characteristics: Provide SFRM with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing SFRM with appropriate markings of applicable testing and inspecting agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" acceptable to authorities having jurisdiction, for SFRM serving as direct-applied protection tested per ASTM E 119.
2. Surface-Burning Characteristics: ASTM E 84.

F. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

G. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Extent of Mockups: Approximately 100 sq. ft. of surface for each product indicated.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is **40 deg F** or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.9 COORDINATION

A. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
6. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
      b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SFRM

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Concealed Cementitious SFRM:
      a. Carboline Co., Fireproofing Products Div.; AD Southwest Type 5GP.
      b. Carboline Co., Fireproofing Products Div.; A-20 Accelerator.
      c. Grace, W. R. & Co. - Conn., Construction Products Div.; Monokote Type MK-6, MK-6/HY, and MK-6s.
      d. Grace, W. R. & Co. - Conn., Construction Products Div.; Retro-Gard.
      e. Isolatek International Corp.; Cafco 300.
      f. Isolatek International Corp.; Cafco 300 SB.

B. Material Composition: Manufacturer's standard product, as follows:
   1. Concealed Cementitious SFRM: Factory-mixed, dry formulation of gypsum or portland cement binders, additives, and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
1. Dry Density: 15 lb/cu. ft. for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
2. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605:

    a. Where the referenced fire-resistance design lists a thickness of 1 inch or more, the minimum allowable individual thickness of SFRM is the design thickness minus 0.25 inch.
    b. Where the referenced fire-resistance design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of SFRM is the greater of 0.375 inch or 75 percent of the design thickness.
    c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft..
3. Bond Strength: 150 lbf/sq. ft. minimum per ASTM E 736 based on laboratory testing of 0.75-inch minimum thickness of SFRM.
4. Compressive Strength: 5.21 lbf/sq. in. minimum per ASTM E 761. Minimum thickness of SFRM tested shall be 0.75 inch and minimum dry density shall be as specified but not less than 15 lb/cu. ft..
5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of SFRM is 0.75 inch, maximum dry density is 15 lb/cu. ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 0.
10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

2.2 EXPOSED SFRM

A. Products: Subject to compliance with requirements, provide one of the following:
1. Exposed Cementitious SFRM:

    a. Carboline Co., Fireproofing Products Div.; AD Southwest Type 5MD.
    b. Carboline Co., Fireproofing Products Div.; A-20 Accelator.
    c. Carboline Co., Fireproofing Products Div.; Pyrocrete 40.
    d. Carboline Co., Fireproofing Products Div.; Pyrocrete 240 High Yield.
    e. Carboline Co., Fireproofing Products Div.; Pyrocrete 241.
    f. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106G.
    g. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106.
    h. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106/HY.
    i. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z146.
    j. Isolatek International Corp.; Cafco 400.
    k. Isolatek International Corp.; Fendolite M-II.

B. Material Composition: Manufacturer's standard product, as follows:
1. Exposed Cementitious SFRM: Factory-mixed, dry, cement aggregate formulation; or chloride-free formulation of gypsum or portland cement binders, additives, and inorganic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
1. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method," but with an average density of not less than 22 lb/cu. ft..
2. Bond Strength: 434 lbf/sq. ft. minimum per ASTM E 736.
3. Compressive Strength: 51 lbf/sq. in. minimum per ASTM E 761.
4. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method," but with an average density of not less than 39 lb/cu. ft..
5. Bond Strength: 1000 lbf/sq. ft. minimum per ASTM E 736.
6. Compressive Strength: 300 lbf/sq. in. minimum per ASTM E 761.
7. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
8. Deflection: No cracking, spalling, or delamination per ASTM E 759.
9. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. per ASTM E 859.
11. Combustion Characteristics: Passes ASTM E 136.
12. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 0.
13. Fungal Resistance: No observed growth on specimens per ASTM G 21.
14. For exterior applications of SFRM, provide formulation listed and labeled by testing and inspecting agency acceptable to authorities having jurisdiction for surfaces exposed to exterior.

2.3 INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

A. Products: Subject to compliance with requirements, provide one of the following:
1. Fire-Resistive, Water-Based, Intumescent Mastic Coating Material:

    a. Carboline Company, Fireproofing Products Div.; Firefilm III Topcoat is required for those areas receiving color only.

        Level 3 Finish: for all or portions of exposed steel receiving intumescent coatings, provide Level 3 finish, back rolled and sanded to a smooth finish before top coated for color. Provide locations to Architect for review and approvals.

    b. Level 1 or Level 2 is sufficient for all concealed steel receiving intumescent coatings.

    c. Carboline Solvent based Intumescent ThermoSorb VOC Topcoat is optional for color only
    d. Isolatek International Corp.; Cafco SprayFilm-WB 2 Basecoat and Topseal.
    e. Isolatek International Corp.; Cafco SprayFilm-WB 3 Basecoat and topcoat recommended by manufacturer of basecoat.

B. Fire-Resistive, Intumescent Mastic Coating: Factory-mixed formulation.
1. Water-Based Formulation: Approved by manufacturer and authorities having jurisdiction and investigated for Interior General Purpose by UL.
2. Multicomponent system consisting of intumescent base coat and topcoat.

C. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with SFRM and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
   1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
   2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of SFRM per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of SFRM.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive SFRM.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of SFRM.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of intumescent mastic coating fire-resistive material. Include pins and attachment.

G. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.
   1. Product: Subject to compliance with requirements, provide Carboline TC-55 Bond sealer
   2. "Cafco Bond-Seal" by Isolatek International Corp.

H. Topcoat: Type recommended in writing by manufacturer of each SFRM for application over exposed SFRM

2.5 NATATORIUM – CONCEALED AND EXPOSED INTUMESCENT MASTIC FIRE-RESISTIVE AND HIGH-PERFORMANCE COATING SYSTEM.

A. Description:

Provide a complete, high-performance, corrosion-resistant intumescent fireproofing system suitable for use in interior humid and chlorinated natatorium environments.

System shall be by Carboline Company and shall consist of compatible primer, intumescent fireproofing, and topcoat products applied in strict accordance with manufacturer’s written instructions.

B. System Components (in order of application):
   1. Primer
      a. Product: Carboline Carbomastic 94
      b. Type: High solids, aluminum-pigmented epoxy mastic coating.
      c. Purpose: Provides corrosion-resistant base and enhances adhesion of intumescent coating to structural steel in high humidity and chlorinated atmospheres.
      d. Application: Apply to clean, prepared steel surfaces prior to application of intumescent coating.
      e. Dry Film Thickness (DFT): 4–6 mils per manufacturer’s recommendation.
      f. VOC: <340 g/L.
      g. Color: Aluminum gray.
      h. Reference Standard: SSPC-PA 1; compatible with Thermolag E100S.

2. Intumescent Fireproofing
   a. Product: Carboline *Thermolag E100S*
   b. Type: Two-component, epoxy-based, intumescent fire-resistive material (IFRM).
   c. Purpose: Provides fire-resistance rating of 1- to 3-hours (UL design dependent) for structural steel members.
   d. Application: Spray-applied or trowel-applied to achieve required thickness in accordance with UL design assemblies.
   e. Typical DFT Range: 150–700 mils, depending on required fire rating.
   f. Performance Requirements:
      - Tested in accordance with ASTM E119 / UL 263.
      - UL Listed and approved for both interior and exterior exposures.
      - Bond Strength: Minimum 150 psi (ASTM E736).
      - Hardness: >65 Shore D.
      - Thermal Expansion: Intumescent expansion factor 5–10x original thickness when exposed to fire.
   g. **Environmental Suitability:**
      - Suitable for chlorine/chloramine-rich atmospheres typical of natatorium environments.
      - High humidity and chemical exposure resistant.
      - **Color:** Off-white (field topcoated as specified).

3. TopCoat Intumescent Fireproofing
   a. Product: Carboline Carbomastic 94 (same as primer) or other Carboline-approved compatible topcoat.
   b. Purpose: Protects intumescent coating from moisture, chemicals, and abrasion while providing uniform architectural appearance.
   c. Application: Apply only after Thermolag E100S has fully cured.
   d. DFT: 4–6 mils per coat; minimum 8 mils total for humid pool environments.
   e. Color and Finish: As selected by Architect from manufacturer's full range.
   f. Optional Alternate Topcoat: Carboline ThermoSorb VOC (for aesthetic topcoat only).

C. System Performance:
   1. Fire Rating: UL Listed 1- to 3-hour protection for steel beams, columns, and joists per UL designs (e.g., UL Design No. WJ110, Y737, X777 or equivalent).
   2. Humidity/Corrosion Resistance: Complies with ASTM B117 and ISO 12944 for immersion-grade epoxy coatings; resistant to chloramine exposure.
   3. Adhesion Compatibility: Primer and topcoat fully compatible with Thermolag E100S system as tested and warranted by Carboline.
   4. Temperature Range: Continuous service –20°F to 200°F; intermittent up to 300°F.
   5. VOC Compliance: Complies with SCAQMD Rule 1113 and national VOC regulations.

D. Submittals:

   Provide the following in addition to Section 1.5 requirements:
   1. Manufacturer's system data sheet listing all components, application sequence, cure times, and UL design references.
   2. Compatibility documentation confirming primer, intumescent, and topcoat are part of a tested and approved system.
   3. Project-specific written warranty covering adhesion, corrosion, and fire-resistance performance for minimum 5 years.
   4. Certificates of Compliance verifying product suitability for humid, chlorinated environments.

E. Application Notes:
   1. All steel surfaces shall be cleaned to SSPC-SP6 (Commercial Blast) minimum prior to primer application.
   2. Primer shall be fully cured prior to application of Thermolag E100S.
   3. Intumescent coating shall be applied in multiple passes as required to achieve total DFT.

4. Final topcoat shall be applied only after full cure of Thermolag E100S, typically 7–14 days depending on temperature and humidity
5. All application work shall be performed by a Carboline-certified applicator experienced with Thermolag systems.

F. Warranty:

Provide Carboline 5-Year System Warranty covering adhesion, corrosion, and fire performance for the full coating assembly (primer, intumescent, topcoat).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Verify that concrete work on steel deck has been completed.

C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work are completed.

D. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.

B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.

C. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.

D. For exposed applications, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of SFRM. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION, GENERAL

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Apply SFRM that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.

C. Install metal lath and reinforcing fabric as required to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use, whether explicitly indicated or not. Securely attach lath and fabric to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by SFRM manufacturer. Attach accessories where indicated or required for secure attachment of lath and fabric to substrate.

D. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by SFRM manufacturer for material and application indicated.

E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.

F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.

G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply SFRM that differs in color from that of encapsulant over which it is applied.

H. Where sealers are used, apply products that are tinted to differentiate them from SFRM over which they are applied.

3.4 APPLICATION, CONCEALED SFRM

A. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed SFRM" Article.

B. Cure concealed SFRM according to product manufacturer's written recommendations.

3.5 APPLICATION, EXPOSED SFRM

A. Apply exposed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if indicated.
   1. For steel beams and bracing, provide a thickness of not less than 1 inch.
   2. For metal floor or roof decks, provide a thickness of not less than 1/2 inch.

B. Provide a uniform finish complying with description indicated for each type of material and matching Architect's sample or, if none, finish approved for field-erected mockup.

C. Apply exposed cementitious SFRM to produce one of the following finishes, as directed by Architect:
   1. Skip-troweled finish with leveled surface, smoothed-out texture, and neat edges.
   2. Smooth, troweled finish with surface markings eliminated and edges squared.

D. Apply exposed sprayed-fiber fire-resistive material to produce the following finish:
   1. Spray-textured finish.
   2. Sealer.
   3. Topcoat.

E. Cure exposed SFRM according to product manufacturer's written recommendations.

3.6 APPLICATION, INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

A. Apply intumescent mastic fire-resistive coatings in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition. Apply where indicated, and wherever application of SFRM would produce dimensional conflicts and where intumescent coating would not produce similar conflicts.

B. Apply intumescent mastic fire-resistive coating as follows:
   1. Install reinforcing fabric as required to obtain designated fire-resistance rating and where indicated.
   2. Finish: Even, spray-textured finish produced by lightly rolling flat surfaces of fire-protected members before fire-resistive material dries, to smooth out surface irregularities and to seal in surface fibers.

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspection and prepare reports:
   1. SFRM.
   2. Intumescent mastic coasting.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
   1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

C. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
   1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.
   2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
   3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
   4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.

      a. Field test SFRM that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
      b. If surfaces of structural steel receiving SFRM are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. minimum per ASTM E 736.

5. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

D. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.

E. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

3.8 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect SFRM, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.

C. Coordinate application of SFRM with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect SFRM and patch any damaged or removed areas.

D. Repair or replace work that has not successfully protected steel.

END OF SECTION 07 81 00

SECTION **07 84 13** - **PENETRATION FIRESTOPPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

B. Related Sections:
   1. Division 07 Section 07 84 46 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Not used.

C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

D. Qualification Data: For qualified Installer.

E. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
   a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
   b. Classification markings on penetration firestopping correspond to designations listed by the following:
      1) UL in its "Fire Resistance Directory."

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. A/D Fire Protection Systems Inc.
   2. Grace Construction Products.
   3. Hilti, Inc.
   4. Johns Manville.
   5. Nelson Firestop Products.
   6. NUCO Inc.
   7. Passive Fire Protection Partners.
   8. RectorSeal Corporation.
   9. Specified Technologies Inc.
   10. 3M Fire Protection Products.
   11. Tremco, Inc.; Tremco Fire Protection Systems Group.
   12. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance

rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire walls fire-barrier walls smoke-barrier walls and fire partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include floors and floor/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. Omit

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.

5. Manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.6 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestopping with No Penetrating Items:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 0001-0999.
   2. Type of Fill Materials: As required to achieve rating.

C. Firestopping for Metallic Pipes, Conduit, or Tubing:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 1001-1999.
   2. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Electrical Cables:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 3001-3999.
   2. Type of Fill Materials: As required to achieve rating.

E. Firestopping for Insulated Pipes:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 5001-5999.
   2. Type of Fill Materials: As required to achieve rating.

F. Firestopping for Miscellaneous Electrical Penetrants:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 6001-6999.
   2. Type of Fill Materials: As required to achieve rating.

G. Firestopping for Miscellaneous Mechanical Penetrants:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 7001-7999.
   2. Type of Fill Materials: As required to achieve rating.

H. Firestopping for Groupings of Penetrants:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 8001-8999.
   2. Type of Fill Materials: As required to achieve rating.

END OF SECTION 07 84 13

SECTION 07 84 46 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Joints in or between fire-resistance-rated constructions.
   2. Joints at exterior curtain-wall/floor intersections including Perimeter fire containment at slab edges, including fire safing between floor slabs and curtain walls
   3. Joints in smoke barriers.

B. Related Sections:
   1. Division 07 Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
   1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For qualified Installer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
   1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
      a. Fire-resistive joint system products bear classification marking of qualified testing agency.
      b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
         1) UL in its "Fire Resistance Directory."

B. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
   1. Joints include those installed in or between fire-resistance-rated walls floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
   2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
   3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. A/D Fire Protection Systems Inc.
      b. CEMCO.
      c. Fire Trak Corp.
      d. Grace Construction Products.
      e. Hilti, Inc.
      f. Johns Manville.
      g. Nelson Firestop Products.
      h. NUCO Inc.
      i. Passive Fire Protection Partners.
      j. RectorSeal Corporation.
      k. Specified Technologies Inc.
      l. 3M Fire Protection Products.
      m. Tremco, Inc.; Tremco Fire Protection Systems Group.
      n. USG Corporation.

C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.

1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30 inch wg at both ambient and elevated temperatures.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. A/D Fire Protection Systems Inc.
    b. Grace Construction Products.
    c. Hilti, Inc.
    d. Johns Manville.
    e. Nelson Firestop Products.
    f. NUCO Inc.
    g. Passive Fire Protection Partners.
    h. RectorSeal Corporation.
    i. Specified Technologies Inc.
    j. 3M Fire Protection Products.
    k. Tremco, Inc.; Tremco Fire Protection Systems Group.
    l. USG Corporation.

3. **Perimeter Fire Containment**: At intersections between horizontal floor assemblies and nonrated exterior curtain walls, provide fire-resistive joint systems (fire safing insulation and sealant) tested in accordance with ASTM E2307.

D. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Provide fire-resistive joint systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Floor-to-Floor, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.
   3. W-Rating: No leakage of water at completion of water leakage testing.

C. Wall-to-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

D. Floor-to-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

E. Head-of-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

F. Bottom-of-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

G. Wall-to-Wall, Fire-Resistive Joint Systems Intended for Use as Corner Guards:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

H. Perimeter Fire-Resistive Joint Systems:
   1. Integrity Rating: 2 hours.
   2. Insulation Rating: 1 hour.
   3. Linear Opening Width: As indicated, maximum

I: Perimeter Fire-Resistive Joint Systems – Fire Safing at Slab Edge and Curtain Wall

1. Location: Between horizontal concrete slabs and nonrated exterior curtain walls

2. Test Standard: ASTM E2307

3. Assembly Rating (Integrity): 2 hours

4. Insulation Rating: 1 hour

5. Linear Opening Width: As indicated on Drawings, maximum

6. Movement Capability: As tested; accommodate expected building movement

7. System Type: UL-classified perimeter fire containment system

8. Typical System Numbers (select based on tested configurations and manufacturer):
   - Hilti CW-D-1014
   - STI ASJ120-07
   - 3M CW-S-1016
   - Tremco FAS 0099

END OF SECTION 07 84 46

SECTION 079200 - JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Urethane joint sealants.
2. Mildew-resistant joint sealants.
3. Butyl joint sealants.
4. Latex joint sealants.
5. Compressible foam sealants

B. Related Requirements:

1. Section 03 30 00 Cast -In-Place Concrete for Concrete Sealants
2. Section 04 20 00 Unit Masonry
3. Section 05 40 00 Cold Formed Metal Framing for Compressible Joint Sealants
4. Section 07 84 46 fire-Resistive Joint Systems
5. Section 32, Exterior Improvements, Concrete Paving Joint Sealant for sealing joints in paved roads, parking lots, walkways, and curbing.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Provide sealant adhesion pull testing in accordance with ASTM C1521 for mock up(s).

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Bostik, Arkema
   b. Master Builders Solutions, brand of MBCC Group, a Sika Company
   c. PPG Paints: PPG Industries, Inc.
   d. Pecora Corporation
   e. Sika Corporation – Building Componants
   f. Tremco Incorporated

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. PPG Paints; PPG Industries, Inc.
   b. Sika Corporation - Building Components.
   c. The Dow Chemical Company.
   d. Tremco Incorporated.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bostik, Inc.
   b. Pecora Corporation.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Pecora Corporation.
   b. Sherwin-Williams Company (The).
   c. Tremco Incorporated.

2.6 SILICONE JOINT SEALANTS

A. Silicone Joint Sealants

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. GE Construction Sealants: Momentive Performance Materials, Inc.
   b. Pecora Corporation
   c. Sika Corporation – Building Componants
   d. The Dow Chemical Company
   e. Tremco Incorporated

2. Silicone Joint Sealants in Natatorium and adjacent areas:
   a. To be chlorine Resistant. Provide all product documentation and warranties.

2.7 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.1 COMPRESSIBLE FOAM SEALANTS

A. A. Material: Pre-compressed, impregnated open-cell polyurethane or acrylic foam sealant, factory pre-coated with an adhesive or mastic facing and packaged in a pre-compressed state for field expansion after installation.

B. Performance Requirements:

1. Movement Capability: Minimum ±25 percent of nominal joint width.
2. Air Infiltration: ≤ 0.01 cfm/ft² at 1.57 psf (per ASTM E283).
3. Water Penetration: No leakage at 6.24 psf (per ASTM E331).
4. Temperature Range: Serviceable from -40°F to +185°F (-40°C to +85°C).
5. UV and Ozone Resistance: No deterioration per ASTM G155.

C. Compatibility: Confirm compatibility with adjacent sealants, coatings, and substrates.

D. Basis-of-Design Product:

1. EMSEAL – Emseal Emseal IB or AST Sealant (Watertight Impregnated Foam Seal).
2. Sika – Sika Emprise or Emseal WFR2.
3. BASF – MasterSeal NP 1 Pre-Compressed Foam Seal (or equal).

E. Color: As selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Cast Stone
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
    a. Perform 5 tests for the first 500 feet of joint length for each kind of sealant and joint substrate.

b. Perform one test for each 500 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Control and expansion joints in unit masonry.

b. Joints in dimension stone cladding.
c. Joints between metal panels.
d. Joints between different materials listed above.
e. Perimeter joints between materials listed above and frames of doors windows and louvers.
f. .
g. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT .
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:
   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doorsandwindows .
   c. .
   d. Other joints as indicated on Drawings.
2. Joint Sealant: Acrylic latex .
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. .
   d. Other joints as indicated on Drawings.
2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT .
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

END OF SECTION 079200

SECTION 07 95 13 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion joint cover assemblies for floor, wall, and ceiling surfaces.

1.2 RELATED REQUIREMENTS

A. Section 07 71 00 - Roof Specialties: Roof expansion joints.

B. Section 07 90 05 - Joint Sealers: Expansion and control joint finishing utilizing a sealant and bond breaker.

C. Section 09 21 16 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.3 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2010.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.

E. ASTM E1399/E1399M - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems; 1997 (2013).

F. ASTM E1612/E1612M - Standard Specification for Preformed Architectural Compression Seals for Buildings and Parking Structures; 1994 (Change 1, 2013).

G. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. See Section 01 33 00 - Submittal Procedures, for submittal procedures.

C. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.

D. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.

E. Samples: Submit two samples 12 inch long, illustrating profile, dimension, color, and finish selected.

F. Test Reports.

G. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

1.5 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for expansion joint covers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Expansion Joint Cover Assemblies:
   1. Construction Specialties, Inc: www.c-sgroup.com. BASIS-OF-DESIGN (see drawings)
   2. Inpro: www.inprocorp.com.
   3. MM Systems Corp: www.mmsystemscorp.com.
   4. Watson Bowman Acme Corp.: www.wbacorp.com.
   5. Balco Inc.: www.balcousa.com.

B. Preformed Compressible Expansion Joint Seal:
   1. Emseal Joint Systems: www.emseal.com.
   2. Watson Bowman Acme Corp.: www.wbacorp.com.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Joint Cover Styles: As scheduled.
   4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
   5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
   7. Provide inside and outside corner joint cover for wall-to-wall junction to complement wall-to-wall joint cover.

B. Floor Joint Covers: Coordinate with indicated floor coverings.
   1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
   2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
   3. Joint Cover Styles: No Bump.
   4. Centering Bar: Provide to maintain position of center cover plate between side frames.
   5. Provide joint cover for floor-wall junction to complement floor-to-floor joint cover.

C. Recessed Cover Plate: Recessed to accept field-applied finish materials.
   1. Recess Depth: As required to accommodate adjacent flooring.

D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.

E. Covers In Gypsum Board Assemblies: Provide style with surface mounted snap-on receivers with sliding center plate.

F. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

2.3 PREFORMED COMPRESSIBLE EXPANSION JOINT SEAL

A. Flexible profile manufactured from open-cell polyether urethane foam with a factory applied elastomeric silicone membrane coating designed to provide protection against moisture and water intrusion on vertical surfaces.
   1. Profile capable of providing a minimum of plus or minus 25 percent building movement and accommodate moderate variations in width of opening, complex directional change transitions and resist ultraviolet degradation.
   2. Coated on one side with pressure-sensitive adhesive and covered with protective wrapping
   3. Profile installed without use of field applied adhesives or invasive anchor systems.
   4. 100 percent free of wax or asphalt compounds.

2.4 PERFORMANCE REQUIREMENTS

A. Materials and systems tested to provide fire rating equal to that of the adjacent construction.
   1. Tested under positive pressure according to ASTM E119 or ASTM E814.

B. Floor covers shall resist a maximum point load of 2000 pounds without damage or permanent deflection.

C. Movement capacity of joint covers in compliance with test results of ASTM E1399/E1399M.

2.5 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
   1. Exposed Finish at Floors: Mill finish or natural anodized.
   2. Exposed Finish at Walls: Natural anodized.
   3. Exposed Finish at Ceilings: Painted white finish.

B. Resilient Seals:
   1. For Ceilings: Neoprene or Santoprene resilient material, flush, pleated, or hollow gasket; Shore A hardness of 40 to 75 Durometer.
   2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.

C. Silicone Facing: Custom color as selected.

D. Anchors and Fasteners: As recommended by cover manufacturer.

E. Compression Seals: ASTM E1612/E1612M preformed elastomeric extrusions.

F. Resilient Filler Exposed to View: Gray.

G. Threaded Fasteners: Stainless steel.

H. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

I. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period.

J. Moisture Barrier: 7-ply laminate reinforced polyethylene.

2.6 ACCESSORIES

A. Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

B. Furnish frame depth for floor joints to accommodate floor finish thickness.

3.2 PREPARATION

A. Provide anchoring devices for installation and embedding under Section 03 30 00.
   1. Provide templates and rough-in measurements.

3.3 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
   1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

C. Align work plumb and level, flush with adjacent surfaces.

D. Rigidly anchor to substrate to prevent misalignment.

E. Precompressed Expansion Joint Seal: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

B. Provide strippable coating to protect finish surface.

3.5 SCHEDULE

		Model #	Comments
1ST FLOOR	**2" Expansion Joint**		
	Floor	NONE	
	Wall	FWF 200M FB	FIRE BARRIER
		FWF 200	
	Ceiling	PCW 200	
		ASM 200	
		FCF 200	
		ASMCX	
		FCFC 200	
	Exterior	VRF+SF 400	
		VF 300	

2ND FLOOR	**3" Expansion Joint**

	Floor	SSR 300	
		PCS 2G 300	
	Wall	FWF 300	FIRE BARRIER
		PCW 300	FLOOR TO WALL
		PCW 2G 300 FB	FIRE BARRIER
	Ceiling	ASM 300	
		FCF 300	
		ASMCX 300	
	Exterior	VRF+SF 400	
		ASM 300 FB	FIRE BARRIER
		PCW 2G 300	

3RD FLR		**3" Expansion Joint**	
	Floor	PCS 300	
	Wall	FWF 300	
	Ceiling	ASMCX 300	
		ASMC 300	
	Exterior	VRF+SF 400	
		VFR 400	
		BRJW-EJ R 400	

4TH FLR		**4" Expansion Joint**	
	Floor	PCW 2G 400 R	
	Wall		
	Ceiling		
	Exterior	VRF+SF 400	
		BRJ WC R 400	

ROOF		**4" Expansion Joint**	
	Exterior	VRF+SF 400	
		BRJ WC R 400	

3.6 SCHEDULE (EXTERIOR)

A. Wall to Wall Joint, Recess Mounted: Preformed compressible expansion joint seal.
   1. Basis of Design: Emseal, Colorseal
   2. Type: Compression Seal.
   3. Face color: Silicone facing in selected color to match adjacent wall color.
   4. Size as required to provide weathertight seal when installed.

END OF SECTION

DIVISION

07

THERMAL AND MOISTURE PROTECTION

SECTION 07 13 00 - SHEET WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheet Waterproofing:
   1. Modified bitumen sheet membrane.

1.2 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation: Insulation used for protective cover.

B. Section 07 90 05 - Joint Sealers: Sealant for joints in substrates.

1.3 ABBREVIATIONS

1.4 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

C. ASTM D5957 - Standard Guide for Flood Testing Horizontal Waterproofing Installations; 1998 (Reapproved 2013).

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

E. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

1.5 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide data for membrane.

C. VOC Content: certification of data indicating VOC (Volatile Organic Compound) content of all components of waterproofing system.

D. Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section

B. Installer Qualifications: Company specializing in performing work of the type specified

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Grace Construction Products; Product Bituthene 3000; www.na.graceconstruction.com.

B. Other Acceptable Manufacturers:
   1. Henry Company; Product Blueskin WP200: www.henry.com.
   2. W.R. Meadows, Inc; Product Mel-Rol: www.wrmeadows.com.
   3. Carlisle Coatings & Waterproofing Incorporated; MiraDRI 860/861: www.carlisle-ccw.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MEMBRANE MATERIALS

A. Modified Bituminous Sheet Membrane: Asphalt and polymer modifiers of SBS type, reinforced with non-woven polyester; smooth surfaced.
   1. Formulated for seaming by contact adhesive.
   2. Thickness: 1/16 inch.
   3. Sheet Width: 36 inch, minimum.
   4. Tensile Strength: 325 psi, measured in accordance with ASTM D412.
   5. Ultimate Elongation: 300 percent, measured in accordance with ASTM D412.
   6. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, water immersion.
   7. Water Vapor Permeability: 0.05 perm inch, measured in accordance with ASTM E96/E96M.

B. Primer: Compatible with membrane; as recommended by membrane manufacturer.

C. Rubberized Mastic: Compatible with membrane; as recommended by membrane manufacturer.

D. Liquid Membrane: Compatible with membrane; as recommended by membrane manufacturer.

2.3 ACCESSORIES

A. Protection Board: 1/8 inch thick bitumen impregnated glass fiberboard .

B. Cant Strips: Premolded composition material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.

E. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

3.3 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.

D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

G. Coordinate with drain installation; see Division 22.

H. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

I. Seal membrane and flashings to adjoining surfaces.

3.4 INSTALLATION - DRAINAGE PANEL and PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.

B. Protection board not required when drainage matting or insulation board is applied over membrane material.

C. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.

D. Adhere protection board to substrate with compatible adhesive.

3.5 FIELD QUALITY CONTROL

A. On completion of horizontal membrane installation, dam installation area in preparation for flood testing in accordance with ASTM D5957.

B. Flood to minimum depth of 1 inch with clean water, and after 48 hours inspect for leaks.

C. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.

D. When area is proven watertight, drain water and remove dam.

3.6 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

3.7 SCHEDULE

A. Modified bituminous membrane, self-adhering.
   1. Elevator pit walls.
   2. Planter basin, vertical sides and bottom slab.
   3. Exterior side of pool walls
   4. Retaining walls.

END OF SECTION

SECTION 07 13 13 - UNDERSLAB VAPORPROOFING / WATERPROOFING MEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underslab vaporproofing/waterproofing membrane in horizontal applications.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-In-Place Concrete

B. Section 03 30 01 Under Slab Vapor Barrier

C. Section 07 13 00 - Sheet Waterproofing

D. Section 07 62 00 - Sheet Metal Flashing and Trim

1.3 REFERENCE STANDARDS

A. ASTM D5957 - Standard Guide for Flood Testing Horizontal Waterproofing Installations; 1998 (Reapproved 2013).

B. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

C. ASTM E1993/E1993M - Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs; 1998 (Reapproved 2013).

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

E. ASTM F1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor; 2006 (Reapproved 2011).

F. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.4 SUBMITTALS

A. See Section 01 33 00, for submittal procedures.

B. Product Data: Provide data for membrane and accessories.

C. Manufacturer's Installation Instructions: Indicate special procedures.

D. Certificate: Certify that products meet or exceed specified requirements.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA ML104 for waterproofing system.

B. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with three years experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide two year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. W.R. Meadows, Inc: www.wrmeadows.com.or approved equal.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MEMBRANE MATERIALS

A. Bituminous Vaporproofing / Waterproofing Membrane: ASTM E1993/E1993M, seven-ply, asphalt-coated, permanently bonded, semi-flexible bituminous core board composed of a 3-ply plasmatic matrix, sealed between liners of asphalt-impregnated felt and a glass mat liner and covered with a polyethylene anti-stick sheet.
   1. Weight: 1.60 lb/ sq ft.
   2. Width: 48 inch, minimum.
   3. Water Vapor Permeability: 0.0011 perms, minimum in accordance with ASTM F1249, calibrated to ASTM E96/E96M, Water Method.
   4. Tensile Strength: 156 lb force/inch, measured in accordance with ASTM E154/E154M, Section 9.
   5. Puncture Resistance: 149 lb. force in accordance with ASTM E154/E154M.
   6. Product: Premolded Membrane Vapor Seal with Plasmatic Core manufactured by W. R. Meadows.

2.3 ACCESSORIES

A. Bonding Asphalt: Catalytic Bonding Asphalt manufactured by W. R. Meadows.

B. Adhesive: Pointing Mastic manufactured by W. R. Meadows.

C. Joint Tape: PMPC Tape manufactured by W. R. Meadows.

D. Pointing Mastic: Pointing Mastic manufactured by W. R. Meadows.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of membrane system.

C. Verify that items that penetrate surfaces to receive membrane are securely installed.

3.2 PREPARATION

A. Prepare surfaces to receive membrane in accordance with manufacturer's instructions.

B. Do not apply membrane to surfaces unacceptable to membrane manufacturer.

3.3 INSTALLATION - MEMBRANE

A. Apply membrane in accordance with manufacturer's instructions to provide a permanent, monolithic vapor seal without voids or open seams.

B. Ensure accessory materials are compatible with membrane and approved by membrane manufacturer.

C. Place membrane in position by either Dutch lap method with laps sealed with bonding asphalt or by butt joint method with joints sealed with joint tape.

D. Point exposed edges with pointing mastic to prevent water from traveling under membrane.

E. Coordinate with drain installation; see Section 22 10 10 Plumbing Piping
Extend waterproofing material into drain clamp
flange; apply adequate coating of bonding asphalt to assure clamp ring seal.

F. In accordance with manufacturer's installation instructions, place membrane collar around penetrations through concrete slab, including pipes, conduits and utility devices to create a positive seal between penetrations and membrane. Seal in place with joint tape and point around penetrations with pointing mastic.

G. Adhere membrane to vertical surfaces with adhesive.

H. Install counterflashing over all exposed edges.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. On completion of horizontal membrane installation, dam installation area in preparation for flood testing in accordance with ASTM D5957.

C. Flood to minimum depth of 2 inch with clean water. After 48 hours, inspect for leaks.

D. If leaking is found, remove water, repair leaking areas with new membrane materials as directed by Architect; repeat flood test. Repair damage to building.

E. When area is proven watertight, drain water and remove dam.

F. Representatives of Contractor and membrane manufacturer shall be present for final inspection.

3.5 PROTECTION

A. Protect membrane from damage until placement of concrete.

3.6 SCHEDULE

A. Bituminous Vaporproofing / Waterproofing Membrane:
1. Install at grade supported slabs. Extend membrane 3 feet beyond perimeter of such areas. Seal membrane edges with adjacent below-grade sheet vapor retarders.
2. Install at grade supported slabs located below water table.
3. Horizontal underslab applications beneath cast-in place concrete

END OF SECTION

SECTION 07 16 14 - POLYMER MODIFIED CEMENT WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polymer modified cement waterproofing.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete to be waterproofed.

1.3 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.

B. ASTM C666/C666M - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing; 2015.

C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Details of joints and intersections.

C. Certification: Provide manufacturer's certification that waterproofing to be provided is suitable for the purpose specified and the locations where it is intended to be installed and that the requirements of the contract documents do not preclude satisfactory installation and performance.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging, marked with manufacturer's product identification.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Keep stored products dry; store under cover and elevated above grade.

1.7 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. See Section 01 77 00 Closeout Procedures or additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Polymer-Modified Cement Waterproofing:
   1. BASF Construction Chemicals-Building Systems MasterSeal 550: www.buildingsystems.basf.com.

2.2 MATERIALS

A. Polymer-Modified Cement Waterproofing : Manufactured slurry coating of Portland or hydraulic cement, aggregates, polymer admixtures, and water; no solvents; for application directly to cementitious substrate.
   1. Explicitly recommended by manufacturer as waterproofing, not simply as dampproofing.
   2. Requiring green concrete cure time of not more than 28 days.
   3. Elongation at Failure: 20 percent, minimum, when tested in accordance with ASTM D412.
   4. Water Vapor Transmission: MINIMUM permeance of finished coating of 1 perm, when tested in accordance with ASTM E96/E96M.
   5. Freeze-Thaw Durability: No change when tested in accordance with ASTM C666/C666M for 300 cycles.
   6. Compressive Strength: 5,000 psi, minimum, at 28 days, when tested in accordance with ASTM C109/C109M.
   7. Finished Coating Thickness: As recommended by manufacturer for the specific application but not less than 1/16 inch.

B. Crack Repair Material, Joint Tape, and Reinforcing: Type and application as recommended by waterproofing manufacturer.

C. Water: Clean, clear, non-alkaline potable water, free of salts and other harmful elements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces where waterproofing is to be applied for conditions detrimental to satisfactory performance.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Remove defective concrete and rebuild to original profiles.

B. Plug active leaks according to waterproofing manufacturer's instructions.

C. Patch holes and non-moving cracks and joints.

D. Clean and prepare surfaces thoroughly prior to installation; schedule cleaning and preparation so that residue will not fall on newly coated, uncured surfaces.

E. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Use sandblasting, water blasting, or acid etching as recommended.

F. Application of waterproofing constitutes acceptance of substrates.

G. Protect other work from fallout, overspray, and spatter from waterproofing application; provide temporary enclosures and covers as necessary to do so.

3.3 INSTALLATION

A. Install waterproofing in accordance with manufacturer's instructions and recommendations unless more stringent requirements are indicated.

B. Perform installation only during ambient and substrate conditions recommended by manufacturer; provide temporary enclosures and/or temporary heating as necessary to do so.

C. Fill voids and holes prior to application of first coat.

D. Apply the number of coats and at the rates recommended by manufacturer for the specific application but not less than specified minimum thickness; apply at least two coats unless one coat is specifically indicated.

E. At surfaces exposed to view, apply a uniformly textured finish without major variations in appearance.

F. Extend waterproofing to all surfaces in areas indicated to form continuous waterproofed surfaces.

G. Cure waterproofing by recommended methods for recommended period prior to making waterproofed area available for use or occupancy; protect from too rapid drying, severe weather exposure, and water accumulation.
   1. Hot, Dry Weather: Use wet-cure methods regardless of manufacturer's instructions.
   2. Do not use covers that could stain waterproofing surfaces.
   3. Do not use chemical curing agents unless explicitly approved by waterproofing manufacturer.
   4. Do not expose waterproofing to sunlight for minimum of 72 hours after placement.

H. Do not backfill, fill water or liquid holding structures, or apply finish coatings until time period recommended by manufacturer has passed.

3.4 FIELD QUALITY CONTROL - WATER HOLDING STRUCTURES

A. Flood test waterproofing application by filling to capacity and allowing to stand for not less than 24 hours.

B. If any leaks appear, notify Architect and drain.
   1. Repair leaks at no additional cost to Owner.
   2. Repeat flood test until all leakage is eliminated.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 SCHEDULE

A. Surface - applied above or on concrete (vertical /horizontal) protection from water intrusion

B. Pool and water holding structures.

END OF SECTION

SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Crystalline waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference TBD.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

C. Surface shall be protected from rain, frost, or excessive drying for minimum 48 hours following application.

PART 2 – PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Crystalline Waterproofing: Prepackaged, [gray] [white]-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with

water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.

1. Schomburg / AQUAFIN or approved equal suitable for Houma, Louisiana.

2. Water Permeability: Maximum [zero for water at 30 feet (9 m)] hydrostatic pressure when tested according to COE CRD-C 48.

3. Compressive Strength: Minimum [4000 psi (27.6 MPa)] at 28 days when tested according to ASTM C109/C109M.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; and compatible with substrate and other materials indicated.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

C. Water: Potable.

2.3 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

B. Mix only enough material for immediate use; use within working time specified by manufacturer (typically 20 to 30 minutes).

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions and the following practices:

1. Surfaces shall be structurally sound, fully cured, and free of dust, dirt, oil, grease, curing compounds, laitance, paint, form release agents, or other contaminants.

2. Prepare surface by high-pressure water blasting, sandblasting, or equivalent mechanical method to open capillaries and ensure absorption.

3. Do not use acid etching.

4. Ensure surface is in saturated surface-dry (SSD) condition at time of application: uniformly damp but free of standing water.

B. Protect adjacent work from damage caused by preparation or application of waterproofing.

C. Do not allow waterproofing, patching, and plugging materials to enter annular spaces intended for resilient sealants or gaskets.

D. Plug active leaks using manufacturer-approved plugging compound prior to waterproofing.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch (1.6 mm) wide or larger, remove loose material, cut to reveal with sides perpendicular to surface, minimum 1 inch (25 mm) deep. Fill flush with patching compound.

3.2 INSTALLATION

A. Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate prepared surface with clean water for several hours prior to application. Maintain SSD condition.

2. Apply waterproofing uniformly by brush, spray, or trowel in [two] [three] <Insert number> coats to required thickness.

3. Apply second and subsequent coats while the previous coat is green (not fully dry), or pre-dampen if fully dried.

4. Extend waterproofing onto adjacent surfaces:

a. Onto integral columns and footings within treated areas.

b. Minimum 12 inches (300 mm) up vertical surfaces from treated floors.

c. Onto intersecting walls (interior and exterior) as specified.

d. At trenches, sumps, pits, pipe chases, and similar elements.

5. Application shall be continuous and uniform with full contact to substrate and complete coverage of pores and irregularities.

6. Provide neat termination lines and prevent bridging or buildup at edges.

7. Dampen surface between coats.

B. Final Coat Finish: [Smooth] [Brushed] [Spray textured] as required.

C. Do not apply during rain or when substrate is frozen.

D. Coordinate sequencing with other trades to ensure penetrations, embedded items, and surface preparation is complete before application.

3.3 CURING AND PROTECTION

A. Moist-Cure: Begin immediately after final coat has set.

1. Keep surface damp using misting, fog spray, or wet burlap for a minimum of [3] days.

2. Prevent surface from drying out during curing period; protect from frost, rain, and direct sun.

3. Do not use curing compounds or plastic sheeting unless approved by manufacturer.

B. Prevent damage to installed coating by foot traffic, backfill operations, or other construction activity.

C. Do not expose treated surfaces to hydrostatic pressure or submersion until full cure is achieved.

END OF SECTION 071616

SECTION 07 18 00 - TRAFFIC COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied membrane coating for waterproofing and traffic surface.

1.2 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

B. ASTM D4259 - Standard Practice for Abrading Concrete; 1988 (Reapproved 2012).

C. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2014.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.

H. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of the work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Requirements, for submittal procedures.

B. Product Data: Include product characteristics and limitations. Identify dissolving solvents, fuels, and potential destructive compounds.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

D. Samples: Submit two samples of cured membrane, 4x4 inch in size, illustrating color, surface texture, and variations.

E. Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer's Installation Instructions: Include special field conditions required to install traffic membrane and potential incompatibilities with adjacent materials.

G. Maintenance Data: Include procedures for stain removal, repairing surface, and cleaning.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing installation of traffic membrane, with minimum three years documented experience and approved by manufacturer.

C. Compatibility: Provide traffic coating, joint sealants, backings, and other related materials that are compatible with one another and with substrates under conditions of service and application, as demonstrated by traffic coating manufacturer, based on testing and field experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Maintain storage area at minimum ambient temperature of 55 degrees F.

B. Keep away from fire or open flame.

1.7 FIELD CONDITIONS

A. Do not install materials when temperature is below 40 degrees F or when surface temperature is above 115 degrees F.

B. Maintain this temperature range, 24 hours before, during and 72 hours after application.

C. Restrict traffic from area where materials are being installed or are curing.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Manufacturer's standard form in which traffic coating manufacturer agrees to repair or replace traffic coatings that deteriorate during the specified warranty period. Warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.
   1. Deterioration of traffic coatings includes the following:
      a. Adhesive or cohesive failures.
      b. Abrasion or tearing failures.
      c. Surface crazing or spalling.
      d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
   2. Warranty Period: Five years from date of Substantial Completion.

C. Applicator's Warranty: Correct defective Work within a two year period after Date of Substantial Completion.
   1. Non-compliance and defective work includes the following:
      a. Adhesive or cohesive failures.
      b. Abrasion or tearing failures.
      c. Surface crazing or spalling.
      d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
   2. Warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.

3. Applicator Maintenance: For two years after completion and acceptance of the traffic coating membrane, provide a 24 hour/7 days per week 1-hour call back response for repair of system failures including leaks.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Polyurethane Traffic Coating:
   1. BASF; MasterSeal Traffic 1500: www,master-builders-solutions.basf.us.
   2. Substitutions: See Section 01 25 00 Substitution Procedures and Substitution Request Form

2.2 TRAFFIC COATINGS

A. Pedestrian Polyurethane Waterproof Coating System: Fluid applied, moisture-curing, polyurethane system with base and top coat.
   1. Finished Coating Thickness: 55 mils, 0.055 inch, minimum.
   2. Color: As selected by Architect.
   3. Manufacturers:
      a. BASF; MasterSeal Traffic 1500: www,master-builders-solutions.basf.us.

2.3 MATERIALS

A. Coatings - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.

B. Membrane: Fluid applied two component polyurethane; waterproof; color as selected; conforming to the following:
   1. Type TC-1, Pedestrian 2 coat system
      a. Base coat, 30 dry mils minimum
      b. Top coat, 15 dry mils minimum
   2. Physical Properties: Meet or exceed manufacturer's published properties.

C. Surfacing: Silica sand, compatible with coating compound, as recommended by coating manufacturer.

D. Elastic Flashings: 60 mil thick neoprene as recommended by coating manufacturer.

E. Joint Cover Sheet: 60 mil think elastic sheet material designed for and compatible with coating.

F. Filler and Primer: As recommended by membrane manufacturer.

G. Sealant: PVC Membrane, butyl rod or other support material, as recommended by membrane manufacturer, and compatible with system and adjacent materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing dimensions and details prior to installation of materials.

B. Verify that substrate is ready to receive work, surface is clean, dry and free of substances that could adversely affect bond.

C. Do not begin work until concrete substrate has cured at least 28 days and moisture content is 16 percent or less.

D. Ensure that curing compound and hardener are compatible with specified coating. Remove incompatible hardeners and compounds according to manufacturer's instructions.

E. Verify that concrete sub-floor surfaces are ready for traffic coating installation by testing for moisture emission rate and alkalinity according to ASTM F1869 procedures; obtain instructions if test results are not within limits recommended by traffic coating manufacturer.
   1. At lightweight concrete, gypsum concrete and patching and leveling compounds, test in accordance with ASTM F2170.

F. Ensure that drains, sleeves and curbs that pass through surfaces to receive coating are properly and rigidly installed.

G. Ensure that surfaces are free of cracks, depressions, waves or projections that may be detrimental to proper installation of coating membrane.

3.2 PREPARATION

A. Clean substrate surface free of foreign matter.

B. Patch concrete substrate with filler to produce surface conducive to bond.

C. Apply 12 inch wide strip of joint cover sheet over cracks, non-working joints, and expansion joints over 1/16 inch, but not exceeding 1/2 inch wide.

D. At expansion joints from 1/2 inch to 1 inch in width, loop cover sheet down into joint a distance of 1-1/4 to 1-3/4 inches. Extend sheet minimum of 6 inches on both sides of expansion joint.

E. Center cover over cracks and joints. Roll sheet into 1/8 inch coating of waterproof membrane. Apply second coat over sheet edge extending a minimum of 6 inches beyond sheet edges.

F. Protect adjacent surfaces.

G. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
   1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
   2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in the reference standard.
   3. Remove and replace areas of defective concrete as specified in Section 03 30 00.
   4. Prepare concrete for adhesive bonded traffic coating using mechanical methods in accordance with ASTM D4259.

H. Temporarily close off deck drains and other deck penetrations to prevent spillage and migration of traffic-coating fluids. Re-open deck drains at the end of each work day or when rain is imminent.

3.3 INSTALLATION

A. Apply system materials in accordance with manufacturer's instructions.

B. Apply primer to prepared substrate at rate recommended by manufacturer.

C. When base coat is tack free, apply one coat of top coating to a minimum dry film thickness recommended by coating manufacturer.

D. Extend primer, base and top coats up intersecting and perimeter vertical surfaces, 4 inches. Terminate top edge in a straight line.

E. Finish to smooth surface sloped to drains. Cove at vertical surfaces.

F. Seal items projecting through coating.

G. Install coating over joints, both static and moving.

H. Do not apply traffic paint for striping and other markings until traffic coating has cured according to manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Verify the applied thickness before the material attains final set, by use of a mil-thickness gauge as the work progresses. Immediately apply additional coating to produce required thickness where readings indicate a thickness less than that specified.

C. Visually inspect areas which cannot be water tested for voids, damage, or rupture. Repair as required.

D. Replace Work or materials damaged beyond repair, in opinion of Architect, at no cost to Owner.

3.5 PROTECTION

A. Allow top coating to cure for 48 hours minimum before permitting traffic on surfaces. At temperatures less than 75 degrees F and relative humidity less the 50 percent, extend curing time.

3.6 CLEANING

A. Clean stains from adjacent surfaces with cleaning agent recommended by coating manufacturer.

B. Remove foreign matter from finished coating surfaces.

END OF SECTION

SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:

1. Cast stone.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.

1. Water Repellents: Comply with performance requirements specified, as determined by testing on manufacturer's standard substrate assemblies representing those indicated for this Project.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.

1. Cast Stone: ASTM C 1195.

C. Water-Vapor Transmission: Comply with one or both of the following:

1. Maximum 15 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96/E 96M.
2. Minimum 90 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

F. Visual Evidence of Water Repulsiveness: Visual inspection.

1. Treated materials give visual evidence of widespread surface hydrophobia: visible beading.

a. Minimum surface area displaying water beading: 100% for first 18 months, 90% through remainder of warranty.

2. Treated materials give little to no evidence of water absorption: surface discoloration, deepening of hue, indicating water penetration.

a. Maximum surface area visibly wetted: 0% for first 18 months, 10% through remainder of warranty.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard colors.
3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

B. Samples: For each type and color of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

C. Qualification Data: For qualified Applicator.

D. Product Certificates: For each type of water repellent, from manufacturer.

E. Preconstruction Testing Reports: For water-repellent-treated substrates.

F. Field quality-control reports.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."

C. Mockups: Apply water repellent to each type of substrate required.

1. Locate each test application as directed by Architect.
2. Size: 25 sq. ft..
3. Final approval by Architect of color and water-repellent application will be from test applications.

1.6 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
5. Rain or snow is not predicted within 24 hours.
6. Not less than three days have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period, as well as materials and surrounding construction damaged from

subsequent water infiltration. This warranty is to include both the replacement of the materials themselves and the cost of the labor to make them seamless.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Siloxane, Penetrating Water Repellent: Clear, containing 15 percent or more solids of oligomerous alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Chemical Products Industries, Inc.; CP-500W.
b. ChemMasters; Aquanil Plus WB.
c. Conproco Corporation; Conpro Shield MX.
d. Dayton Superior Corporation; Weather Worker WB Heavy Duty (J-27-WB).
e. Diedrich Technologies, Inc.; 303-C.
f. Euclid Chemical Company (The), an RPM company; Euco-Guard VOX.
g. H&C Concrete Care Products, Sherwin-Williams Company (The); H&C SX-7.
h. Price Research, Ltd.; Price Aqua Seal-20.
i. Rainguard Products Company; MicroSeal.
j. SaverSystems; DEFY Water Repellent for Brick.
k. Specco Industries, Inc.; Waterstopper S-10 WB Siloxane.
l. Tamms Industries, Inc., Euclid Chemical Company (The); Baracade M.E.
m. Textured Coatings of America, Inc.; Rainstopper 1500.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
4. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

1. Cast Stone: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
2. Portland Cement Plaster (Stucco): ASTM E 1857.

B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using 15 psi-pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Cast Stone: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 19 00

SECTION 07 21 00 – THERMAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY A. Section Includes:

1. Extruded Polystyrene (XPS) Foam-Plastic Board Insulation – Continuous insulation behind masonry, foundation walls, and brick veneer.
2. Polyisocyanurate (Polyiso) Foam-Plastic Board Insulation – Continuous insulation behind metal panels, sheathing, and roofing assemblies.
3. Glass-Fiber Blanket Insulation – Interior soffits, partitions, suspended ceilings; thermal and acoustic applications.
4. Mineral Fiber Board Insulation – Curtain wall spandrel zones, backup walls, and exterior sheathing.
5. Mineral Wool Batt Insulation – Interior and exterior framed walls, spandrels, floors, and soffits; thermal, acoustic, and fire-rated applications.
6. Batt Insulation – Interior framed partitions, floors, and soffits; acoustic and fire-rated applications.
7. Insulation for Miscellaneous Voids – Glass-fiber loose fill or spray polyurethane foam for gaps, shim spaces, and irregular cavities.

B. Related Requirements:

1. Section 05 40 00 – Cold-Formed Metal Framing
2. Section 07 27 26 – Fluid Applied Waterproofing Assembly. s.
3. Section 07 52 16 - Styrene-Butadiene-Styrene (SBS) Modified Bituminous Roofing
4. Section 07 84 46 Fire Resistive Joint systems
5. Section 09 21 16 – Gypsum Board Assemblies: Acoustic insulation.

1.2 REFERENCE STANDARDS

A. ASTM C518 – Thermal Conductivity of Insulation Materials.

B. ASTM C578 – Extruded Polystyrene Foam Board.

C. ASTM C612 – Mineral Fiber Board.

D. ASTM C665 – Glass-Fiber Batt Insulation.

E. ASTM C1289 – Polyisocyanurate Board Insulation.

F. ASTM C764 – Loose-Fill Glass-Fiber Insulation.

G. ASTM C1029 – Spray Polyurethane Foam.

H. ASTM E84 – Surface-Burning Characteristics.

I. ASTM E119 – Fire-Resistance Ratings.

J. UL 263 – Fire-Resistance Assemblies.

K. NFPA 285 – Fire Propagation.

L. ASTM C1114 – Mineral Wool Batt Insulation.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data – Manufacturer's installation instructions, R-value labeling, accessory data; applicable to XPS board, Polyiso board, Glass-fiber blanket, Mineral fiber board, Mineral wool batt, Batt insulation, Miscellaneous void insulation, Accessories.Installation Methods – Detailed installation methods for rated assemblies, cavity walls, framed construction, and miscellaneous voids; applicable to all insulation types.
2. Sample R-Value Labels – Demonstrate correct labeling and dimension compliance; applicable to XPS, Polyiso, Glass-fiber blanket, Mineral fiber board, Batt insulation.
3. Fire-Rated Assembly Compliance – Verification of insulation products in UL or equivalent rated assemblies; applicable to XPS, Polyiso, Mineral fiber board, Batt insulation.
4. Fire-Rated Assembly Compliance – Verification of insulation products in UL or equivalent rated assemblies; applicable to XPS, Polyiso, Mineral fiber board, Mineral wool batt, Batt insulation.

B. Informational Submittals:

1. Product Test Reports – High-heat performance, flame spread, smoke development, surface-burning, and fire propagation; applicable to XPS, Polyiso, Glass-fiber blanket, Mineral fiber board, Batt insulation, Loose-fill, Spray polyurethane foam.
2. ASTM Compliance Reports – Documentation confirming compliance with ASTM standards (C518, C578, C612, C665, C1289, C764, C1029, E84, E119, UL 263, NFPA 285); applicable to all insulation types.
3. Manufacturer Certifications – Verification of product origin, quality, and conformance to specified standards; applicable to all insulation types and accessories.

4. UL / Agency Listings – Copies of listings for rated assemblies, where insulation is part of fire-resistance or high-heat assemblies; applicable to XPS, Polyiso, Mineral fiber board, Batt insulation.

1.4 QUALITY ASSURANCE

A. Prefer insulation products from a single manufacturer where feasible.

B. Fire-rated and UL-rated assemblies must use insulation approved by the applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.6 FIELD CONDITIONS

A. Do not install on wet or frozen substrates or in unsuitable weather conditions.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE (XPS) BOARD

A. For use on exterior walls outside of sheathing line for continuous insulation as required by Energy Code behind brick veneer locations.

B. Extruded Polystyrene Board Insulation, Type IV, with Drainage Panels : ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Owens Corning; Foamular NGX 250 or comparable product by one of the following:
   a. Atlas Wall Insulation (Energy Shield XR)
   b. DuPont de Nemours, Inc. (Styrofoam Square Edge)
2. AT RATED ASSEMBLIES: Where indicated in the Contract Documents provide rigid insulation as specifically required by the UL Listed Assembly or Assemblies indicated regardless of whether or not product appears in the list above as the insulation indicated would be required in order to achieve the rating. When and wherever possible keep insulation in same manufacturer as rest of the Project.

2.3 POLYISOCYANURATE (POLYISO) BOARD

A. For use on exterior walls outside of sheathing line for continuous insulation as required by Energy Code behind metal panel locations

B. Polyisocyanurate Board Insulation, Foil Faced : ASTM C1289, foil faced, Type I, Class 1 or 2.

1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; Thermax™ Basic NH or comparable product by one of the following:
   a. Atlas Polyiso Roof and Wall Insulation - Energy Shield Pro.
   b. Johns Manville; a Berkshire Hathaway company - AP Foil 25.
2. AT RATED ASSEMBLIES: Where indicated in the Contract Documents provide rigid insulation as specifically required by the UL Listed Assembly or Assemblies indicated regardless of whether or not product appears in the list above as the insulation indicated would be required in order to achieve the rating. When and wherever possible keep insulation in same manufacturer as rest of the Project.

2.4 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed; SAINT-GOBAIN.

b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

2.5 MINERAL FIBER BOARD INSULATION

A. ASTM C612, semi-rigid or rigid.

B. Basis-of-Design – Thermafiber FireSpan 90 or equal.

C. Applications – Curtain wall spandrels, backup walls, exterior sheathing.

2.6 BATT INSULATION

A. ASTM C665, unfaced or kraft-faced; flame-spread and smoke-developed per ASTM E84 limits.

B. Basis-of-Design –Basis-of-Design – CertainTeed, Johns Manville, or Owens Corning (glass-fiber batt).Interior framed partitions, floors, soffits; acoustic or fire-rated walls.

C. Applications – Interior framed partitions, floors, soffits; acoustic or fire-rated walls.

2.7 MINERAL WOOL BATT INSULATION

A. ASTM C1114, unfaced or kraft-faced; flame-spread ≤25, smoke-developed ≤50..

B. Basis-of-Design – Roxul ComfortBatt, Thermafiber SAFB, or equal..

C. Applications – Interior and exterior framed walls, spandrels, floors, soffits; acoustic, thermal, or fire-rated assemblies

2.8 INSULATION FOR MISCELLANEOUS VOIDS

A. Glass-fiber loose fill – ASTM C764 Type II, flame-spread 5 (ASTM E84).

B. Spray polyurethane foam – ASTM C1029 Type II, closed-cell; flame-spread ≤75, smoke ≤450.

C. Applications – Fill gaps, shim spaces, and irregular cavities around MEP penetrations.

D. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.9 ACCESSORIES

A. Mechanical fasteners, insulation washers, adhesive, support bars, wire mesh, and other components as required.

B. Vapor retarders/barriers where indicated on Drawings, compatible with insulation type.

C. Joint sealing tapes, sealants, and closure strips per manufacturer's instructions.

PART 3 – EXECUTION

3.1 PREPARATION

A. Clean substrates; remove sharp projections.

B. Verify substrates are dry and suitable for insulation adhesion or mechanical fastening.

3.2 INSTALLATION – GENERAL

A. Install per manufacturer instructions.

B. Fit insulation tightly; avoid voids or compression of blanket/batt insulation.

C. Coordinate with other trades for penetrations, flashing, and rated assemblies.

3.3 INSTALLATION BY APPLICATION

A. XPS Board – Continuous behind masonry, foundation walls, slab edges; adhere or mechanically fasten.

B. Polyiso Board – Continuous behind metal panels, sheathing, roofing systems.

C. Glass-Fiber Blanket – Above ceiling grids or within soffit framing; prevent sagging.

D. Mineral Fiber Board – Fit in curtain wall spandrels; use retainers or T-bars.

E. Mineral Wool Batt – Place in stud wall cavities or framed spandrels; support with wire, mesh, or friction fit; avoid compression to maintain R-value.

F. Batt Insulation – Place in stud wall cavities; support with wire or mesh if exposed.

G. Miscellaneous Voids – Fill with loose-fill glass-fiber or spray polyurethane foam.

3.4 INSTALLATION IN FRAMED CONSTRUCTION

A. Cut insulation to fit cavities; friction-fit or mechanically support as required.

B. Maintain clearances around non-rated recessed lighting.

C. For high metal-stud walls, support unfaced blankets mechanically; tape flanges for faced blankets.

3.5 INSTALLATION OF RIGID BOARD INSULATION

A. Install per manufacturer instructions and project drawings.

B. Abut joints tightly; do not tape or seal unless specified. C. Avoid small, irregular infill pieces.

3.6 PROTECTION

A. Protect installed insulation from moisture, weather, and physical damage.

B. Provide temporary coverings if permanent concealment is not immediate.

END OF SECTION 07 21 00

SECTION 072119 – FOAMED-IN-PLACE INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam (SPF) insulation.
2. Open-cell spray polyurethane foam (SPF) insulation.
3. Ignition barriers for spray foam insulation.

B. Related Requirements:

1. Section 075700 "Coated Foamed Roofing" for spray polyurethane foam insulation used in roofing applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each insulation and ignition barrier product, include:

1. Manufacturer’s technical data sheets.
2. Installation instructions.
3. Surface preparation and curing requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Indicate compliance with ASTM, ICC-ES, and NFPA standards.

B. Research Reports: Provide ICC-ES evaluation reports or equivalent.

PART 2 – PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell SPF Insulation:

1. Type: ASTM C1029, Type II.
2. Minimum Density: 1.5 lb/cu. ft. (24 kg/cu. m).
3. Minimum Aged R-Value at 1 inch (25.4 mm): 6.2°F·h·ft^2/Btu at 75°F (43 K·m^2/W at 24°C).
4. Manufacturers:
   - Johns Manville, or approved equal.

B. Surface-Burning Characteristics (ASTM E84):

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Fire Propagation Characteristics:

1. Complies with NFPA 285 as part of an approved wall assembly.

D. Standards Compliance:
- ASTM C1029
- ASTM E84
- NFPA 285
- ICC-ES AC377

2.2 IGNITION BARRIERS FOR SPRAY FOAM INSULATION

A. Products:

1. Ignition barrier materials compliant with building code for SPF applications in attics, crawl spaces, or concealed areas.
2. Must meet ICC-ES AC377, Appendix X or other applicable standards.

B. Fire Testing Standards:
1. ASTM E84
2. ASTM E119
3. NFPA 286
4. ICC-ES AC377, Appendix X

C. Submittals:

1. Product data sheets for ignition barriers.
2. Fire test reports from approved laboratories.
3. Manufacturer's installation guidelines.

D. Quality Assurance:

1. Installer Qualifications:
   - Manufacturer-trained and certified for SPF and coatings.
2. Mock-Up:
   - Provide a sample area for Owner/Architect review.

E. Delivery, Storage, and Handling:
- Deliver in original sealed containers with clear identification.
- Store in dry, covered conditions per manufacturer's instructions.

2.3 OPEN-CELL SPRAY POLYURETHANE FOAM

A. Open-Cell SPF Insulation:

1. Blowing Agent: Water-based.
2. Minimum Density: 0.4 lb/cu. ft. (6.4 kg/cu. m).
3. Minimum Aged R-Value at 1 inch (25.4 mm): 3.4°F·h·ft^2/Btu at 75°F (24 K·m^2/W at 24°C).

4. Manufacturers:
   - Johns Manville, or approved equal.

B. Surface-Burning Characteristics (ASTM E84):

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Fire Propagation Characteristics:

1. Complies with NFPA 285 as part of an approved wall assembly.

D. Standards Compliance:
- ASTM E84
- NFPA 285
- ICC-ES AC377

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
- Install in accordance with manufacturer's written instructions.

B. Application:

1. Apply foam to completely envelop all insulated areas and fill voids.
2. Apply in multiple lifts, not exceeding manufacturer's recommended maximum thickness per pass.
3. Do not apply into rising foam; allow curing between passes as required.

C. Ignition Barrier Application:
- Install ignition barrier coating where required, in accordance with manufacturer's installation guidelines and code requirements.

END OF SECTION 072119

SECTION 072726 –

FLUID-APPLIED MEMBRANE AIR BARRIERS

FLUID- APPLIED MEMBRANE VAPOR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections.

1.2 SUMMARY

A. Section Includes:

1. Fluid-applied, vapor-permeable air barrier system.
   Basis-of-Design: PROSOCO R-Guard Cat 5 or approved equal.
2. Fluid-applied, vapor-impermeable air and vapor barrier system.
   Basis-of-Design: PROSOCO R-Guard VB.or approved equal.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
2. Division 07 sections for coordination with roofing, waterproofing, and below-grade vapor barriers.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

D. Vapor-Barrier. is a continuous barrier with very low water vapor permeance, intended to prevent or significantly limit water vapor transmission from one side of a wall, ceiling, or floor to the other.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review air and vapor barrier requirements and installation, special details, mockups, air-leakage and bond testing, barrier protection, and work scheduling that covers both barriers.
2. Coordination with other envelope trades to ensure continuity of air and vapor barrier assemblies.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; wet and dry film thickness; and tested physical and performance properties of products.
2. Include letter from manufacturer that indicates acceptable other flashing materials for adhered or other acceptable means of installation for flashing materials and their integration with the fluid applied system that does not negatively affect the system or warranty.
3. Include letters confirming compatibility with other air / vapor -barrier, vapor barrier or waterproofing systems.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For air / vapor-barrier assemblies.

1. Show locations and extent of air / vapor barrier materials, vapor-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, adhered flashings, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air and vapor barrier.
4. Consult air barrier and vapor barrier manufacturer for additional installation guidelines illustrations to assist with meeting shop drawing requirements.
5. Provide detailing of transitions to roof, floor slabs, and other envelope components.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier and vapor barrier manufacturer, certifying compatibility of barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

.

C. Product Test Reports: For each barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

E. Include documentation of environmental limitations and substrate conditions at time of installation.

1.7 QUALITY ASSURANCE

A. Pre-Construction Meeting.

1. Contractor to provide written agenda and hold meeting prior to any work in order to review mock ups and project specifics, unique conditions and provide minutes of the meeting.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. A company experienced in applying air and vapor barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
2. Verification that Installer completed SWR Institute's Validated Air Barrier and Vapor Barrier Training Program and is approved to perform work as herein specified by air/vapor and water-resistive barrier system and manufacturer.
3. Verification of completion of ABAA or SWR Institute training program

C. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly , 150 sq. ft. , incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, vapor barriers and sealing of gaps, terminations, and penetrations of air-barrier and vapor barrier assembly. Include roof tie-ins and foundation intersections in mockup scope.
   a. Coordinate construction of mockups to permit inspection and testing of air and vapor barriers before external insulation and cladding are installed.
   b. Include junction with roofing membrane , building corner condition, and foundation wall intersection.
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air and vapor barriers until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Manufacturer's Representative: Manufacture's authorized representative is required to visit the site and submit approval in writing that the installation has met the manufacturer's written installation instructions.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier and Vapor Barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers .
2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
3. Adhesion Testing: Mockups will be tested for required air-barrier and vapor barrier adhesion to substrate according to ASTM D 4541.
4. Alternative Adhesion Testing: Mock-ups will be tested for minimum air-barrier and vapor barrier adhesion using the ABAA 16psi air-barrier and vapor barrier membrane requirement as a minimum adhesion of all non-sealant materials using the PROSOCO Field Adhesion Tester or a unit described in ASTM D 4541. All non-sealant items shall be adhesion-tested in the same manner as the air-barrier and vapor barrier membrane. Sealant adhesion testing shall be performed in accordance with the Dow Corning Americas Technical Manual (page 74).
5. Compatibility Determinations: Mock-ups will be inspected for visual signs of decay, chemical attack, or degradation of any kind. Suspect instances shall be reported to the corresponding manufacturer who shall provide a letter that approves moving forward with the project or rejects the use of the product or rejects the method or circumstances of installation with an appropriate explanation of the position taken.
6. When the mock-up testing and compatibility determinations are complete, the Contractor shall submit documentation clarifying all conditions that were reviewed in the mock-up, stating all materials, details and assemblies that are: 1.) exhibited in the mock-up that are in compliance with the Contract Documents, 2.) exhibited in the mock-up that vary from the Contract Documents, and the reasons they vary, and 3.) exhibited in the mock-up that are not shown in the Contract Documents and why they need to be addressed and reviewed now as part of the mock-up process. Decisions made as a result of the mock-up reviews should be noted in this document and accepted via sign-off by all parties.
7. Submit full documentation clarifying all reviewed mockup conditions and deviations from contract documents.
8. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Sequence deliveries to avoid delays, and to minimize on-site storage.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Deliver materials and products in labeled packages.

D. Store and handle in strict compliance with manufacturer's instructions and recommendations.

E. Protect from damage, weather, excessive temperatures, and construction operations.

F. Remove damaged material from site and dispose of in accordance with applicable regulations.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier and vapor barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier and vapor barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier and vapor barrier performance.
2. Do not apply air barrier or vapor barrier to a damp or wet substrate or during snow, rain, fog, or mist.
3. Verify moisture content on concrete via ASTM D 4263 plastic sheet test if applicable

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-/ vapor barrier materials and air/ vapor barrier accessories from single source from single manufacturer.

B. Low-Emitting Materials: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

For PROSOCO R-Guard Cat 5 (vapor-permeable):

PRODUCT TEST RESULTS
R-Guard Cat 5™

PROSOCO

ICC-ES AC212[1] Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing			
TEST	**METHOD**	**CRITERIA**	**RESULTS**
Tensile Bond	ASTM C 297	Minimum 15 psi (105 kPa)	Pass
Freeze-Thaw	ICC-ES AC212	No cracking, checking, crazing, erosion, delamination or other deleterious effects	Pass
Water Resistance	ASTM D 2247	No cracking, checking, crazing, erosion, delamination, or other deleterious effects	Pass
Water Vapor Transmission	ASTM E 96 Wet Cup	Report	14 perms
Water Penetration	ASTM E 331	No visible water penetration at the sheathing joints as viewed from the back of the panel	Pass
Structural, Racking, Restrained Environmental Conditioning & Water Penetration	ASTM E 1233 A ASTM E 72 ICC-ES AC212 ASTM E 331	No cracking of the coating	Pass
Weathering	ICC-ES AC212 AATCC[2] 127	No cracking of the coating; no water penetration	Pass
Air Permeance	ASTM E 2178	≤ 0.02 L / s·m² at 75 Pa (≤ 0.004 cfm / ft² at 1.57 psf)	Pass: 0.0007 L / s·m² at 75 Pa (0.000 cfm / ft² at 1.57 psf)
ABAA: Air Barrier Association of America Acceptance Criteria for Liquid Applied Membranes			
TEST	**METHOD**	**CRITERIA**	**RESULTS**
Air Permeance	ASTM E 2178	≤ 0.02 L / s·m² at 75 Pa (≤ 0.004 cfm / ft² at 1.57 psf)	Pass: 0.0007 L / s·m² at 75 Pa (0.000 cfm / ft² at 1.57 psf)
Air Leakage of Air Barrier Assemblies	ASTM E 2357	≤ 0.2 L / s·m² at 75 Pa (≤ 0.04 cfm / ft² at 1.57 psf)	Pass: 0.0009 L / s·m² at 75 Pa (0.0028 cfm / ft² at 1.57 psf)
Water Resistance	AATCC 127	No water infiltration after exposure to 55 cm head of water for 5 hours	Pass
Fastener Sealability	ASTM D 1970	No water infiltration	Pass
Pull Adhesion	ASTM D 4541	110 kPa (16 psi) or substrate failure	Pass
Crack Bridging	ASTM C 1305	Pass	Pass
Water Vapor Transmission	ASTM E 96 Wet Cup Dry Cup	Report	Wet Cup: 14 perms Dry Cup: 10 perms
Fire Testing			
TEST	**METHOD**	**CRITERIA**	**RESULTS**
Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies	NFPA[3] 285	Must resist flame propagation and flame spread	See Report 10261K Rev. 6 from Priest & Associates Consulting, LLS
Surface Burning Characteristics	ASTM E 84	Criteria for ICC and NFPA Class A Building Material: Flame Spread ≤ 25 Smoke Developed ≤450	Meets Class A Building Material Flame Spread: 25 Smoke Developed: 10

All testing conducted by independent, accredited laboratories.

NOTES:
1: International Code Council Evaluation Service Acceptance Criteria 212
2: American Association of Textile Chemists and Colorists
3: National Fire Protection Association

For PROSOCO R-Guard VB (vapor-impermeable):

PRODUCT TEST RESULTS
R-Guard VB

PROSOCO

TEST	METHOD	CRITERIA	RESULTS
Water Vapor Transmission	ASTM E 96 Dry Cup	Measure	0.063 perms
Water Resistance	ICC-ES AC212[1] AATCC[2] 127	No water infiltration after exposure to 55 cm head of water for 5 hours	Pass
Air Permeance	ASTM E 2178	≤ 0.02 L / s·m² at 75 Pa (≤ 0.004 cfm / ft² at 1.57 psf)	Pass
Air Leakage of Air Barrier Assemblies	ASTM E 2357	≤ 0.2 L / s·m² at 75 Pa (≤ 0.04 cfm / ft² at 1.57 psf)	Pass
Fastener Sealability	ASTM D 1970	No water infiltration	Pass
Pull Adhesion	ASTM D 4541	110 kPa (16 psi) or substrate failure	Pass
Surface Burning Characteristics	ASTM E 84	Criteria for ICC and NFPA Class A Building Material: Flame Spread ≤ 25 Smoke Developed ≤450	Meets Class A Building Material Pass
Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies	NFPA[3] 285	Must resist flame propagation and flame spread.	See Report 10261K Rev. 6 from Priest & Associates Consulting, LLS

All testing was completed by independent, accredited laboratories.

NOTES:
1: International Code Council Evaluation Service Acceptance Criteria 212
2: American Association of Textile Chemists and Colorists
3: National Fire Protection Association

2.3 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier and vapor barrier manufacturer to produce a complete air-barrier and vapor barrier assembly and that are compatible with primary air-barrier and vapor barrier material and adjacent construction to which they may seal.

Accessories shall also be compatible with the vapor barrier properties of the primary material where vapor-retarding performance is required.

1. Liquid-type auxiliary materials shall comply with VOC requirements.
2. Wet-weather accessories compatible with the primary Wet-Weather Fluid Applied Vapor-Permeable Membrane System shall be comprised of Silyl-Terminated-Poly-Ether (STPe).

B. Primer: If and as required by manufacturer / system and applicable locations provide liquid waterborne primer recommended for field-cut edges of external gypsum board substrate by air-barrier/vapor barrier material manufacturer for the purpose of consolidating friable edges.

Primer shall not adversely affect vapor permeability or vapor-retarding properties of air / vapor barrier.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD GypPrime or comparable product by one of the following:
   a. Primers by barrier manufacturer or as recommened or approved for use with manufacturer's product provided on Project .

C. Joint Reinforcing: Sheathing and rough opening seams and joints Filler Material. Liquid Silyl-Terminated-Poly-Ether (STEp) as recommended for treatment of rough openings.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD Joint & Seam or comparable product by one of the following:
   a. WR Grace .
   b. Henry

D. Rough Opening Flashing Material: Liquid Silyl-Terminated-Poly-Ether (STPe) as recommended for treatment of rough openings.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD FastFlash or comparable product by one of the following:
   a. WR Grace .
   b. Henry

E. Substrate-Patching Material: Manufacturer's standard substrate filler as recommended for preparation of cracks and overdriven fasteners, as recommended by barrier manufacturer.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD Joint & Seam Filler per manufacturer’s recommendations or comparable product by one of the following:
   a. Carlisle
   b. GCP .
   c. Henry
   d. Prosoco
   e. Tremco

F. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

G. Preformed Extrusion: If and as required by Manufacturer, provide manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlisle
   b. GCP .
   c. Henry
   d. Prosoco
   e. Tremco

H. Interior Air or vapor Sealant: Single component, moisture curing, 98 percent solids Silyl-Terminated-Polyether (STPe) to produce a durable, high-performance, high-movement sealant for windows and doors.

Ensure compatibility with vapor-retarding or vapor-permeable requirements per manufacturer testing data. Provide manufacturer test results for permeability (perm rating) and adhesion for each product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc.; R-GUARD Dam or comparable product by one of the following:
   a. WR Grace .
   b. Henry
2. Backer Rod: Compressible, closed cell rod stock as recommended by manufacturer for compatibility with sealant. Provide size and shape of rod to control joint depth.

PART 3 - EXECUTION

3.1 GENERAL

A. It is the intent that installation of Fluid Applied Membrane Air Barriers and Vapor Barriers will create a continuous, non interrupted barrier throughout the entire plane in which it is installed. Contractor is responsible to identify and address all penetrations, bridging conditions and tie ins with other materials as required to achieve a continuous barrier as noted herein.

B. Provide overlapping of membranes by a minimum of 12” with taped joints.

3.2 EXAMINATION

- Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by barrier manufacturers.
3. Verify that substrates are visibly dry and free of moisture, unless approved by air / vapor barrier manufacturer. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air/vapor barrier application.

1. Surfaces STPe accessory materials may be dry, damp, or wet to the touch. Brush away any standing water present before application. The products will tolerate rain immediately after application.
2. If installing directly over metal studs provide over only un-punched, solid, studs.

B. Mask off adjoining surfaces not covered by barriers to prevent spillage and overspray affecting other construction.

C. Remove film-forming coatings, curing compounds, and form-release agents from concrete, and grease, oil, bitumen, paints, and other contaminants from all substrates.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another. See STPe product manufacturer's installation guidelines illustrations.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for barriers.

H. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air/ vapor barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

I. Exterior Sheathing:

1. Ensure that sheathing is properly installed with ends, corners, and edges properly fastened. Remove and replace damaged sheathing.

2. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing, fastened and spotted with substrate patching material, and fastened into solid backing.
3. Consolidate and seal the cut edges of gypsum wall boards exposed in rough openings for windows and doors at corners. The treated edge provides a suitable surface for application of joint reinforcing, fiber-reinforced coat and seam treatment.

J. Apply primer to substrates at required rate and allow it to dry, as recommended by barrier manufacturers.

3.4 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and barrier manufacturer's written instructions.
2. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

B. Gypsum Sheathing: Fill joints greater than 1/2 inch with joint reinforcing according to barrier manufacturer's written instructions.

1. Fill surface defects and over driven fasteners.
2. Using a dry knife, trowel, or spatula, tool and spread the product. Spread 1 inch beyond seam at each side to manufacturer's recommended thickness. See manufacturer's product data sheet.
3. Allow to skin before installing other waterproofing or barrier components.
4. Apply in accordance with barrier manufacturer's written instructions.

3.5 ACCESSORIES INSTALLATION

A. Install accessory materials according to barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of barrier.

1. Coordinate the installation of barrier with installation of roofing membrane and base flashing to ensure continuity of barrier with roofing membrane. See manufacturer's installation guidelines illustrations.
2. Install transition strip or liquid-seal materials on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

B. Connect and seal exterior wall barrier material continuously to roofing-membrane barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, penetrations, and doors to seal and waterproof rough openings, as recommended by barrier

manufacturer. Substrates for STPe products do not require primers other than field-cut edges of external gypsum board, such as around rough openings.

1. Apply a thick bead of Rough Opening Joint & Seam Filler over all joints and seams of the rough opening.
2. Apply Rough Opening Filler Material within temperature and weather limitations as required by manufacturer.
3. Apply Rough Opening Filler Material to perimeters, sills, and adjacent sheathing and building face, in accordance with manufacturer's product data sheet and manufacturer's Installation Guidelines illustrations.
4. Apply liquid STPe flashing product to interior surfaces of rough opening and out onto the sheathing or CMU per manufacturer’s instructions.
5. Preformed Silicone Extrusion: Install as recommended by air / vapor barrier manufacturer.

D. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air/ vapor barrier material as recommended by air / vapor barrier manufacturer.

E. Seal masonry reinforcing or ties and penetrations as recommended by air / vapor barrier manufacturer.

F. Seal top of through-wall flashings to air / vapor barrier as recommended by air / vapor barrier manufacturer.

G. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets as recommended by air / vapor barrier manufacturer.

H. Repair punctures, voids, and deficient lapped seams in strips and transition strips as recommended by air / vapor barrier manufacturer.

3.6 PRIMARY BARRIER MATERIAL INSTALLATION

A. Apply barrier material to form a seal with strips and transition strips and to achieve a continuous barrier per manufacturer's written instructions and details. Apply barrier material within manufacturer's recommended application temperature ranges. Air / vapor barrier to be installed so as to create a continuous barrier tying separate components of the building envelope together. This includes connection to the slab and roof systems as well as all other components of the building envelope. The barrier is to be continuous at all joints, terminations and penetrations even where not specifically detailed as such.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. Medium-Build Barriers: Apply continuous unbroken barrier material to substrates according to the thickness required by the barrier manufacturer for the Project conditions. Apply an increased thickness of air / vapor barrier material in full contact around protrusions such as masonry ties.

1. Barrier: Apply dry film thickness as recommended by barrier manufacturer's literature to comply with performance requirements. Apply additional material as needed to achieve void- and pinhole-free surface.

C. Low-Build Barriers: Apply continuous unbroken air / vapor barrier material to substrates according to the following thickness. Apply an increased thickness of air / vapor-barrier material in full contact around protrusions such as masonry ties if applicable.

1. Vapor-Permeable, Low-Build Barrier: Apply dry film thickness as recommended by air / vapor barrier manufacturer's literature to comply with performance requirements. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

D. Do not cover air /vapor barrier until it has been tested and inspected by testing agency.

E. Correct deficiencies in air / vapor barrier that does not comply with requirements; repair substrates and reapply air / vapor-barrier components.

3.7 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Manufacturer's authorized representative shall inspect the following and submit a report of his findings to the Architect. Air/ vapor barrier materials, accessories, and installation are subject to inspection for compliance with requirements.

1. Continuity of barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Wet mil thickness readings: Take during material application with photo documentation provided with daily field reports. Provide 1 gauge reading for every 500 SF of installed material and not less than a minimum of 1 per wall face.
3. Air / vapor barrier dry film thickness.
4. Continuous structural support of air/vapor-barrier system has been provided.
5. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
6. Site conditions for application temperature and dryness of substrates have been maintained.
7. Maximum exposure time of materials to UV deterioration has not been exceeded.
8. Surfaces have been primed, if applicable.
9. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
10. Termination mastic has been applied on cut edges.
11. Strips and transition strips have been firmly adhered to substrate.
12. Compatible materials have been used.
13. Transitions at changes in direction and structural support at gaps have been provided.

14. Connections between assemblies (air / vapor barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
15. Tie offs and connections to disparate systems such as the roof have been made in accordance with the manufacturer's requirements.
16. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air / vapor-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers .
2. Air-Leakage-Volume Testing: Air / vapor-barrier assemblies will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
3. Adhesion Testing: Air / vapor barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air vapor barrier or part thereof.

E. Barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air / vapor -barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air/ vapor barrier components for retesting as specified above.

F. Repair damage to barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. Protect air/vapor-barrier system and vapor- barrier from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace barrier or install additional, full-thickness, barrier application after repairing and preparing the overexposed materials according to barrier manufacturer's written instructions.
2. Protect air / vapor barrier from contact with incompatible materials and sealants not approved by barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 07 4213.24 ALUMINUM METAL WALL

PART 1- GENERAL

1.01 SECTION INCLUDES

A. Aluminum metal plate wall panels

1.02 RELATED REQUIREMENTS

A. Section 05 40 00 – Cold-Formed Metal Framing: Wall panel substrates support framing.

B. Section 06 10 00 – Rough Carpentry: Plywood substrate wall sheathing.

C. Section 07 27 26 – Fluid Applied Membrane Barriers: Air and moisture barrier required as part of metal wall panel assembly.

D. Section 07 62 00 – Sheet Metal Flashing and Trim: Field formed flashings and other sheet metal work.

E. Section 07 92 00 – Joint Sealants: Perimeter sealant.

1.03 DEFINITION

A. Metal Plate Wall Panel and Soffit Assemblies: Metal plate wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weather tight wall system based on AAMA CW-RS-1.

1.04 REFERENCE STANDARDS

A. AAMA - American Architectural Manufacturers Association (www.aamanet.org)
   1. AAMA CW-RS-1 – The Rain Screen Principle and Pressure Equalized Wall Design; 2012
   2. AAMA 501.1 – Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2005
   3. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2009
   4. AAMA 508 – Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems; 2014 [Testing based on 2007 Edition]
   5. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014
   6. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013 [Testing based on 2005 Edition]

B. ASTM International (American Society for Testing and Materials; www.astm.org)
   1. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015
   2. ASTM D523 - Standard Test Method for Specular Gloss; 2014
   3. ASTM D2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2015
   4. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity; 2011
   5. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 07(2015)
   6. ASTM E8/E8M - Standard Test Methods for Tension Testing of Metallic Materials; 2013a
   7. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 04(2012)

8. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014
9. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 00(2009)
10. ASTM E1233/E1233M – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential; 2014 [Testing based on 2006 Edition]

C. TAS - Testing Application Standards; Florida Building Code, 2010
1. TAS 202 – Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure Loading; 1994
2. TAS 203 – Criteria for Testing Products Subject to Cyclic Wind Pressure Loading; 1994

D. NAAMM – National Association of Architectural Metal Manufacturers

E. SMACNA – Sheet Metal and Air Conditioning Contractor's National Association

F. PS - Voluntary Product Standard; National Institute of Standards and Technology (NIST)
1. PS-1 – Structural Plywood; 2009

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate panel assemblies with rain drainage, flashing, trim, stud back-up, soffits, and other adjoining work.

B. Preinstallation Meeting:
1. Attendees:
   a. Owner.
   b. Architect.
   c. Installer.
   d. Panel manufacturer's representative.
   e. Structural support installer's.
   f. Installer's whose work interfaces with or affects wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule.
3. Verify availability of materials, installer's personnel, equipment, and facilities needed to maintain schedule.
4. Review means and methods related to installation, including manufacturer's written instructions.
5. Examine support conditions for compliance with requirements, including alignment and attachment to structural members.
6. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affects this Work.
7. Review temporary protection requirements for during and after installation of this Work.

1.06 SUBMITTALS

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. Product Data: Submit for each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal plate wall panel and accessory.

C. Shop Drawings: Submit fabrication and installation layouts of metal plate wall panels; including details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
1. Provide distinction between factory-assembled, shop-assembled, and field-assembled work.
2. Provide details of following items at full scale.
   a. Manufacturer's standard sheet metal trims.
   b. Components of wall panel construction, anchorage methods, and hardware.

D. Coordination Drawings: Submit exterior elevations, drawn to scale, that have the following items shown and coordinated with each other, using input from installers of the following items:
   1. Metal plate wall panels and attachments.
   2. Girts.
   3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
   4. Penetrations of wall by pipes and utilities.

E. Samples: Submit for each type of exposed finish required, and prepared on samples of size as follows:
   1. Aluminum Metal Plate Wall Panels: At least 2 inch by 3 inch.

F. Test and Inspection Reports: Submit test and inspection reports on each type of wall panel system provided for project based on evaluation of comprehensive tests performed by qualified testing agency.

G. Maintenance Data: Submit maintenance data for metal plate wall panels.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least five years of documented experience.

B. Installer: Company specializing in performing work of this section and approved by manufacturer.
   1. Install system in strict compliance with manufacturer’s installation instructions.

C. Anodized Finish Applicator: Provide either caustic (traditional) or eco-friendly (acid) etching technologies.
   1. Use fully automated, computer-controlled process lines for consistency of finish throughout project.
   2. Use documented production line quality control protocols in accordance with AAMA 611 test procedures.

D. Source Limitations: Obtain each type of metal plate wall panel from single source and from single manufacturer.

1.08 MOCKUPS

A. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and to establish quality standards for fabrication and installation.
   1. Build mockup of typical wall panel assembly**,** including corners and corner soffits, supports, attachments, and accessories.
      a. Include at least four panels to represent a four-way panel joint and showing full thickness.
   2. Water Spray Test: Conduct water-spray test of mockup metal panel assembly, test water penetration in accordance with AAMA 501.2.
   3. Approval of mockups does not constitute approval of deviation from Contract Documents within mockups unless these deviations are approved by Architect in writing.
   4. Subject to compliance with requirements, approved mockups **[may]** or **[may not]** become part of completed Work if undisturbed upon Date of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling: Store materials in clean, dry, interior area in accordance with manufacturer’s instructions.

C. Deliver panels, components, and other manufactured items without damage or deformation.

D. Protect panels during transportation, handling, and installation from weather, excessive temperatures and construction operations.

E. Handle panels in strict compliance with manufacturer's instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface damage.
   1. Store panels vertically with top of panel down, storage of panels horizontally is not permitted.

F. Store panels covered with suitable weather tight and ventilated covering.

G. Provide storage of panels to ensure dryness, with positive slope for drainage of moisture.

H. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

I. Remove strippable protective covering from aluminum panel prior to installation.

1.10 SITE CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work to be performed according to manufacturer's installation instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before panel fabrication and indicate measurements on Shop Drawings.
   1. Coordinate with construction schedule.

1.11 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Wall System Warranty: Provide wall panel manufacturer warranty, agreeing to correct defects in manufacturing of materials within a one year period after Date of Substantial Completion.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking, or puncturing.
      b. Deterioration: Beyond normal weathering of wall system metals and other materials.

C. Panel Material Warranty: Provide panel material manufacturer warranty, agreeing to repair finish of metal plate wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 30 years from Date of Substantial Completion. Warranties for all coating systems to be the same.
   2. Warranty Coverage: In accordance with AAMA 2605 for 70 percent PVDF resin on aluminum finish requirements.
      a. Fading, Loss of Color Retention: Loss of 5 Delta E units (Hunter) or less, in accordance with ASTM D2244.
      b. Chalking, Chalky White Powder on Panel Surface: Chalking at No. 8 or less for colors, or No. 6 for white, in accordance with ASTM D4214.
      c. Loss of Adhesion: Loss of 10 percent due to cracking, checking or peeling, or failure to adhere to bare metal.
      d. Gloss Retention: 50 percent or less in accordance with ASTM D523.
      e. Salt Spray, Accelerated: At least 4,000 hours in accordance with ASTM B117.
      f. Humidity Testing, Accelerated: At least 4,000 hours in accordance with ASTM D2247.
   3. Warranty Coverage: In accordance with AAMA 611 Class 1 anodized aluminum finish requirements.
      a. Loss of Adhesion: Resists cracking, crazing, flaking, and blistering when forming and welding completed prior to finishing; post forming or welding voids warranty.
      b. Fading - Loss of Color Retention: Loss of 5 Delta E units (Hunter) or less, in accordance with ASTM D2244.
      c. Chalking, Chalky White Powder on Panel Surface: Chalking at No. 8 or less in accordance with ASTM D4214.
      d. Test Chlorine resistance in accordance with ASTM rD543.
      e. Coating shall show no blistering, rusting, or degradation after 3,000 hours exposure in a modified ASTM B117 test using a 0.5% sodium hypochlorite solution."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Dri-Design – Aluminum Wall Panel System or approved equal, Basis of Design.
   1. Address: 12480 Superior Ct., Holland, Michigan 49424.
   2. P.O. Box 1286 Holland, Michigan 49422-1286.
   3. Phone: (616) 355-2970; Fax: (616) 355-2972; Website: www.dri-design.com.

2.02 PERFORMANCE REQUIREMENTS

Delegated Design for Metal Wall: Basis of Design: Dri-Design

A. Metal panels and support framing, including panel attachment clips, sub girts, zee clips, sill angles, fasteners for miscellaneous metal framing, plates and bars, Tubes and pipes, joints, etc.

B. Metal Plate Wall Panel Assemblies: Comply with performance requirements without failure due to defective manufacturing, fabrication, installation, or other construction defects

C. Design, fabricate, and erect a dry joint, pressure equalized rainscreen aluminum wall panel system without use of sealants, gaskets, or butyl tape, tested as installed in compliance with AAMA 508, and as follows:
   1. Cyclic Static Air Pressure Differential: Pass cycled pressure loading at 25 psf in 100 three-second cycles in accordance with ASTM E1233/E1233M.
   2. Air Infiltration: Pass when tested at 1.57 psf (25 mph) in accordance with ASTM E283.
   3. Water Penetration:
      a. Static: Pass water penetration test under 25.0 psf positive static air pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with ASTM E331.
      b. Dynamic: Pass water penetration test under 15.0 psf dynamic pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with AAMA 501.1.
   4. Structural: Provide systems tested in accordance with ASTM E330/E330M and certified to be without permanent deformation or failure of structural members.

D. High Velocity Hurricane Zone (HVHZ): Comply with ASTM E8/E8M test methods and performance requirements of Florida Building Code and Miami-Dade County test protocols TAS-202 and TAS-203 for HVHZ with at least plus 61 psf to minus 80 psf design pressure rating.
   1. Application: For aluminum plate thickness of 0.080 inch only.

2.03 MATERIALS

A. Dri -Design - Aluminum Plate: Alloy and temper as recommended by manufacturer for application and in compliance with manufacturers design requirements. Refer to drawings for locations.
   1. Aluminum Material: Tension-leveled, [flouropolymer PVDF painted finish, 3003-H14 manganese alloy] or [anodized finish, 5005-AQ manganese alloy].
   2. Thickness: 0.080 inch.
   3. Weight: Less than 2 lbs per sf.
   4. Color: Refer to drawings for color selections.
   5. Panel Depth: 1-1/4 inch, nominal.
   6. Specifier Note: Maximum panel size for aluminum is 48w x 48h inch, square; 24w x 72h inch, rectangular; 60w x 30h inch, rectangular; 120w x 24h inch, long rectangular.
   7. Panel Size: As indicated on Drawings
   8. Specifier Note: Panel joints are typically 1/2 inch wide for horizontal joints and 5/8 inch wide for vertical joints; 1 inch maximum for each.
   9. Panel Joints: As indicated on Drawings.

2.04 FABRICATION

A. Fabricate and finish wall panels within manufacturer's facilities and fulfill indicated performance requirements demonstrated by laboratory testing.
   1. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide post-finishing of panels, paint aluminum wall panels only after completion of panel fabrication and ensure exposed edges are coated.

C. Provide post anodizing of panels, anodize aluminum wall panels only after completion of panel fabrication and ensure exposed edges are anodic coated without crazing of surface at formed edges.

2.05 FINISHES

A. Comply with NAAMM's - Metal Finishes Manual for Architectural and Metal Products, for recommendations of designating finishes.

B. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride (PVDF) resin system.
   1. **All metal wall panels located within the natatorium** and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.
   2. **All metal wall panels located elsewhere in project shall receive Two-Coat Fluropolymer** AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.
   3. **No anodized Finish allowed within the natatorium** and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure. These areas shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

C. Color Anodized Finish: AAMA 611, Architectural Class I, color anodized coating of 0.0007 inch (0.7 mils) minimum thickness.
   1. Color: From Manufacture's full range. See drawings.

D. Clear Anodized Finish: AAMA 611, Architectural Class I, clear anodized coating of 0.0007 inch (0.7 mils) minimum thickness.

E. Field Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 ACCESSORIES

A. Metal Plate Wall Panel Accessories: Provide components required for a complete metal plate wall panel assembly including trim, copings, fascia, mullions, sills, corner units, flashings, and similar items. Match material and finish of panels unless otherwise indicated.

B. Provide integral drainage system and manufactures standard extrusions at termination of dissimilar materials.

C. Flashing and Trim: Match material, finish, and color of adjacent wall panels.
   1. Thickness: At least 0.040 inch.
   2. Refer to Section 07 62 00 Sheet Metal Flashing and Trim..

D. Panel Fasteners: Designed to withstand design loads, with at least 7/16 inch diameter head and neoprene washer.
   1. Aluminum Wall Panel Material: Provide stainless steel fasteners, or coated fastener approved by panel manufacturer or project wall consultant.

E. Sub-Girts: Galvanized, provide size and gage in accordance with project requirements.
   1. Furring Channel: Provide Hat, C, U or Z type as recommended by manufacturer.

2. Flat Strap: At least 14 gage, 0.0747 inch (1.90 mm) thick.
3. Refer to Section 05 40 00 Cold Formed Framing.

F. Substrate Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I, at least 5/8 inch thick.
1. Refer to Drawings and Section 06 1000 Rough Carpentry for requirements.

G. Weather Barriers: Provide climate specific weather barrier with performance characteristics for air penetration, water vapor transmission, and water penetration resistance. Refer to Section 07 27 26 Fluid Applied Membrane Air Barriers for requirements.

H. Sealants: As recommended by metal panel manufacturer for openings within wall panels and perimeter conditions.
1. Refer to Section 07 92 00 Joint Sealants for requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, and Work areas and conditions with Installer present for compliance with requirements for installation tolerances, wall panel supports, and other conditions affecting performance of this Work.

B. Examine wall framing to verify that girts, angles, channels, studs, and other structural wall panel support members and anchorage have been installed within alignment tolerances required by wall panel manufacturer.

C. Verify that weather barrier has been installed over sheathing or substrate to prevent air infiltration or water penetration.

D. Examine rough-in for components and systems penetrating wall panels to coordinate actual penetration locations relative to wall panel joint locations prior to installation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Framing: Install sub girt, base angles, sills, furring, and other wall panel support members and provide anchorage in accordance with ASTM C754 for gypsum panel type substrates and panel manufacturer’s installation instructions.

3.03 INSTALLATION

A. Install wall and soffit panels in accordance with manufacturer's installation instructions, including pressure equalized rainscreen installation method and installation guidelines.
1. Metal panels consist of single sheets of metal formed with interlocking gutter and drainage system integral to the panel with single horizontal attachment for dry-joint rainscreen assembly.
2. Use of secondary drainage channels, brackets, support pins, joint sealants or gaskets to manage the drainage of wall panel system is not permitted.
3. Attach metal panels using progressive interlocking method, engaging bottom of panel in top of previous panel working bottom up, and left to right.
4. Install metal panels with single top attachment in pre-punched holes to allow individual panels to move due to thermal expansion.
5. Do not compromise internal gutter.

B. Install metal panels for orientation, sizes, and locations as indicated on Drawings.

C. Install metal panels with proper anchorage and other components for this Work securely in place.

D. Install metal panels with provisions for thermal and structural movement.

E. Install shims to plumb substrates as necessary for installation of wall panels.

F. Install weather tight seals at perimeter of wall panel openings.
   1. Test for proper adhesion on small unexposed area of solid surfacing prior to use.
   2. Refer to Section 07 9200.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA - Architectural Sheet Metal Manual.
   1. Provide concealed fasteners where possible, and set units true to line and level as indicated.
   2. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   3. Install flashing and trim as wall panel Work proceeds.

H. Install weather tight escutcheons for pipe and conduit penetrating exterior walls.

I. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by wall panel manufacturer.

J. Install attachment system to support wall and soffit panels and with provisions to provide a complete weather tight wall system, including sub girts, extrusions, flashings and trim.
   1. Include attachment to supports and trims at locations using dissimilar materials.
   2. Do not apply sealants to joints, unless noted otherwise on Drawings or Shop Drawings.
   3. Install starter extrusion at base course and at cut panel locations.

K. Install accessories with positive anchorage to building and weather tight mounting and provisions for thermal expansion, and coordinate installation with flashings and other components.
   1. Install components required for a complete wall panel assembly including trim, copings, flashings and other accessory items.

L. Weather Barrier: Install weather barrier behind wall panels and over substrate in accordance with requirements of Section 07 2500.

3.04 TOLERANCES

A. Shim and align wall panel units with installed tolerances of 1/4 inch in 20 feet, non-cumulative, on level, plumb, and location lines as indicated.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation and in coordination with Mockup requirements, test area of assembly **as directed by Architect** for water penetration in accordance with AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Perform additional tests and inspections, at Contractor's expense, to verify compliance of replaced wall panels or necessary additional work with specified requirements.

F. Prepare test and inspection reports.

3.06 CLEANING

A. Upon completion of wall panel installation, clean finished surfaces as recommended by panel manufacturer.

B. Upon completion of wall panel installation, clear weep holes and drainage channels of obstructions and dirt.

3.07 PROTECTION

A. Protect installed products from damage during subsequent construction.

B. Replace metal panels damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 42 64 METAL COMPOSITE MATERIAL WALL PANEL

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.02 SUMMARY

A. Definition:

1. Metal Composite Material (MCM) System includes MCM, joints, attachment system components and miscellaneous materials as appropriate for the design of the project to provide a weather-resistant exterior cladding system.

B. Section Includes: MCM system installations

1. Applications of MCM system installations include:

a. Exterior installation and performance of MCM and MCM system components.

b. Interior installation and performance of MCM and MCM system components (if applicable).

C. Delegated Design

1. Design of the Metal Composite Material (MCM) system, including engineering of all support, anchorage, and attachment systems, is delegated to the Contractor in accordance with the requirements of Division 01 Section "Delegated Design Requirements

2. The Contractor shall engage a qualified professional engineer, licensed in the project jurisdiction, to prepare all design documentation, including calculations and shop drawings, demonstrating compliance with performance requirements.

D. Related Sections: Section(s) related to this section include:

1. Cold-Formed Metal Framing: Division 05, 05 40 00 Cold Formed Framing
2. Weather Barrier in Cavity Behind MCM: Division 07, 07 27 27 Fluid Applied Membrane air Barrier
3. Sheet Metal Flashing and Trim: Division 07, 07 62 00 Flashing and Trim
4. Joint Sealants: Division 07, 07 90 00 Joint Sealers
5. Glazing: Division 08, 08 44 13 Glazed Aluminum Curtain Walls

1.03 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed have either been identified by the International Building Code (IBC), local building code, or specific requirement for this building construction type.

B. Aluminum Association (AA)

1. Aluminum Design Manual
2. AA-M12C22A41: Anodized - Clear Coating
3. AA-M12C22A44: Anodized - Color Coating

C. American Society of Civil Engineers (ASCE)
   1. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM) International:
   1. ASTM D635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
   2. ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives
   3. ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics
   4. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
   5. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
   6. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference
   7. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Wall, and Doors By Uniform Static Air Pressure Difference
   8. ASTM E1233 Standard test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential

E. American Architectural Manufacturers Association (AAMA):
   1. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
   2. AAMA 501 Methods of Test for Exterior Walls

F. National Fire Protection Association (NFPA):
   1. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.04 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Delegated Design
   2. General Performance: Provide installed MCM system designed to withstand specified loadings while maintaining allowable deflection, thermal movement performance as defined by the Manufacturer, Fabricator, or Installer required by this section without defects, damage or failure

B. Deflection and Thermal Movement: Provide installed MCM systems that have been designed to resist to the wind loading, acting inward and outward, defined for this project:
   1. Perimeter Framing Deflection: Deflection of panel perimeter framing member shall not exceed L/175 normal to plane of the wall where L is the unsupported span of the perimeter framing member.
   2. Panel Deflection: Deflection of the panel face shall not exceed L/60 at design load where L is the unsupported span of the panel.
   3. Anchor Deflection: At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 0.0625 inch (1.6 mm).
   4. At 150% pressure, no permanent deformation exceeding L/1000 or failure to structural members is permitted.

5. Thermal Movements: Allow for free and noiseless horizontal and vertical thermal movement due to expansion and contraction of component parts over a temperature range of -20°F (-29°C) to +180°F (82.2°C) at the material surface.
    a. Buckling, opening of joints, undue stress on fasteners, failure of sealants, or any other detrimental effects of thermal movement will not be permitted.
    b. Fabrication, assembly and erection procedures shall take into account the ambient temperature range at the time of the respective operation.

C. System Requirements:
    1. Wet System – (Tested to AAMA 501 Standard)
        a. ASTM E283 – Air Leakage – Not more than 0.06 cfm per ft^2 of wall area (0.3 L/s▪m^2) when tested at 6.24 psf (300 Pa).
            b. ASTM E331 – Static Water Penetration – When tested under static pressure at 12.0 psf (575 Pa) minimum, for a time period of 15 minutes. MCM systems must have:
            i. No uncontrolled water leakage to the room side of the assembly when tested as defined by the procedure.
        c. AAMA 501.1 – Dynamic Water Penetration – When tested with a wall pressure equivalent to 12.0 psf (575 Pa) for a time period of 15 minutes, the MCM system must have:
            i. No uncontrolled water leakage to the room side of the assembly when tested as defined by the procedure.
        d. ASTM E330 – Structural Performance – MCM system must be engineered to meet the project design loads, however the MCM system must meet or exceed the following criteria when tested to a minimum pressure of 30.0 psf (1436 Pa):
            i. Deflections do not exceed limitations defined within the section on Deflection and Thermal Movement.

D. Fire Performance: Where required by governing code, provide fire retardant MCM that has been evaluated and is in compliance with code requirements specified herein.
    1. Fire Performance: Wall assemblies containing MCM System shall meet the requirements of the Intermediate Scale Multi-story test, NFPA 285, where required by code based for the design of this project.

1.05 SUBMITTALS

A. General: Provide submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.

B. Product Data: For each type of product indicated, include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of MCM System and accessory.

C. Shop Drawings: Submit shop drawings showing elevations and layouts, profiles, and product components, including anchorage, accessories, finish colors, and textures.
    1. Include details showing thickness and dimensions of the system parts, details of edge conditions, attachment system, corners, fastening and anchoring methods, locations of joints and gaskets, location and configuration of joints necessary to accommodate thermal movement, and all trim and flashings.
    2. Provide signed and sealed drawings by a qualified Design Professional licensed in the project jurisdiction, demonstrating conformance with the delegated design scope and the performance requirements identified for this project.

D. System Calculations: Submit MCM System Fabricator's complete system design and engineering

analysis/calculations including, but not limited to the following:

1. Show governing MCM types, mounting system including anchorages, connections, and fasteners. Indicate location, type magnitude, and direction of loads imposed on the building structural frame.
2. Analysis/Calculations shall be signed and sealed by a qualified Design Professional licensed in the project jurisdiction and shall demonstrate that the MCM system conforms to the delegated design scope and specified performance requirements.

E. Samples: Submit selection and verification samples for finishes, colors and textures

1. Selected Samples: Manufacturer's color charts or chips illustrating full range of colors, finishes and patterns available for MCM with factory applied finishes. Custom color selection requires color sample to be submitted for approval. Approval signatures are required by Architect.
    a) MCM System Fabricator shall not have filed for protection from creditors under state or federal insolvency or debtor relief statues or codes.
    b) MCM System Fabricator shall substantiate a track record of one of the Manufacturers listed in this specification working with the Fabricator/Installer for three (3) consecutive years and at a scale of operations cited above.
2. MCM System Installer Qualifications:
    a. The MCM System Installer shall have been in business under the present name for at least five (5) years prior to the start of this project and have experience with similar sized MCM system projects. The MCM System Installer must be capable of providing field service representation during construction.
    b. The MCM System Installer must be an approved installer by a MCA Certified Fabricator for the installation of their MCM System and have undergone proper training for the specified system thereof.

F. Regulatory Code Agencies Requirements: Provide MCM system which have been evaluated and are in compliance with the following, where required:

1. International Code Council (ICC)
2. Miami/Dade County Florida (Notice of Acceptance)
3. State of Florida (Florida Product Approval)

G. Mock-Ups: Install at project site a job mock-up using acceptable products and Fabricator approved details. Obtain Owner's and Architect's acceptance of finish color (draw down samples to be used for color approval of nonstandard coil coated colors), texture and pattern and workmanship standard. Comply with Division 01 Quality Control, 01 90 00, Mock-Up Requirements Section.

1. Mock-Up Size: To provide as detailed in the construction documents
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into final construction upon Architect's approval.
4. Provide Material required for custom color mock-ups at no cost to Owner. (consider special small quantity material runs may increase cost and require additional time to obtain material.

H. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and system Fabricator's installation details.

1.06 PROJECT CONDITIONS

A. Substrate Tolerances: The General Contractor is responsible for providing a substrate with a tolerance of 1/4 inch in 20.0 feet (6mm in 6m), on level, plumb, and location control lines as

indicated and within 1/8 inch (3mm) offset of adjoining faces of alignment of matching profiles tolerances are noncumulative.

B. Field Measurements: Verify locations of wall framing members and wall opening dimensions by field measurements prior the fabrication of the MCM System. Indicate measurements on the “As Built Shop Drawings”. Field measurements to be taken once all substrate materials and adjacent materials are installed.

C. Project Schedule: Provisions in the project schedule must accommodate the time interval between field measurements and fabrication/installation.

1.07 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. MCM Manufacturer’s Material Warranty: Submit, to the Owner, the manufacturer’s standard warranty.

1. Warranty Period:

a. MCM Material Integrity: Five (5) plus 1 years from date of Substantial Completion
b. MCM Painted Finish: Twenty (20) plus 1 years date of Substantial Completion.
c. MCM Natural Metal Surface: No finish warranty

C. MCM System and System Installation Warranty: Submit to the Owner, the MCM Fabricator system’s standard warranty document executed by authorized company official. The MCM system’s assembly warranty is in addition to and not a limitation of, other rights Owner may have under the Contract Documents.

1. Warranty Period

a. MCM System Workmanship: One (1) year warranty period commencing on Date of Substantial Completion.

b. Special Warranty: The MCM System Fabricator will repair or replace components of the MCM System that fails in materials or workmanship within the specified one (1) year warranty period above.

i. Failures include: deterioration of metals and other materials beyond normal weathering; structural failures including rupturing, cracking, puncturing, or loss of bond/adhesion characteristics.

PART 2 – PRODUCTS

2.01 METAL COMPOSITE MATERIAL (MCM) Manufacturers and Premium MCM System Fabricators

A. MCM Manufacturers:

1. Alpolic material manufactured by Mitsubishi Chemicals – www.alpolic-americas.com
2. Alucobond material manufactured by 3A Composites USA, Inc. – www.alucobondusa.com
3. larson material manufactured by Alucoil North America – www.alucoilnorthamerica.com
4. Reynobond material manufactured by Alcoa Architectural Products – www.reynobond.com

B. MCM System Fabricators:

1. Basis of Design: The Miller-Clapperton Partnership, Inc. – www.millerclapperton.com
2. Premium Certified MCM Fabricators recognized by the Metal Construction Association

2.02 METAL COMPOSITE MATERIAL (MCM

A. Material Description
   1. MCM Composition:
      a. Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or liquid adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products that are laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.
   2. MCM Thickness: 4mm (0.157 inch)
   3. MCM Face Sheets:
      a. Thickness: 0.5mm (0.02 inch) (nominal)
   4. MCM Product:
      a. Standard core material product acceptable for use:
         i. Less than 40 feet (12.2m) above grade in general accordance with the provisions of IBC Section 1407, or
         ii. Up to 50 feet (15.2m) above grade when used in general accordance with the specific provisions of IBC Section 1407.11.2 and complying with the performance requirements of ASTM D1929, or
         iii. Up to 75 feet (22.9m) above grade when used in general accordance with the specific provisions of IBC Section 1407.11.3 and complying with the performance requirements of ASTM D1929, ASTM D635 or
         iv. Up to 75 feet (22.9) above grade when used in general accordance with the specific provisions of IBC Section 1407.11.4 and complying with the performance requirements of ASTM D1929, ASTM D635 or
      b. Fire Retardant core material product acceptable for use:
         i. On Construction Type I, see drawings.
   5. Fire Performance: (Class A Material)
      a. ASTM E84: MCM shall have a flame spread index of not more than 25 when tested in the maximum thickness intended for use.
      b. ASTM E84: MCM shall have a smoke developed index of not more than 450 when tested in the maximum thickness intended for use.
   6. Bond Integrity: Tested for resistance to delamination as follows:
      a. Peel Strength (ASTM D1781): 22.5 in-lb/in (100 N-m/m) minimum as manufactured.
      b. No degradation in bond performance after 8 hours of submersion in water at 212°F (100°C) or 21 days of immersion in water at 70°F (21°C).
      c. Thermally bonded to the core material in a continuous process under heat, pressure, and tension.

2.03 FINISH

A. Exterior Finish: Finish shall meet the performance criteria of AAMA 2605.

B. All metal wall panels located within the natatorium and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

C. All metal wall panels located elsewhere in project shall receive Two-Coat Fluropolymer AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

D. No anodized Finish allowed within the natatorium and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure. These areas shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

E. Standard 2-coat and 3 coat finish:

   a. See drawings for color selections.

2.04 ACCESSORIES

A. General: Provide Fabricator’s standard MCM system accessories, including fasteners, clips, anchorage devices, and attachments for specific applications indicated on contract documents.

2.05 RELATED MATERIALS

A. General: Refer to other related sections in Related Sections paragraph specified herein for related materials, including cold-form metal framing, flashing and trim, joint sealants, aluminum windows, glass and glazing and curtain walls.

2.06 FABRICATION

A. General: Shop-fabricate panels to sizes and joint configurations indicated on drawings.

   1. Fabricate panels to dimensions indicated on drawings based on an assumed design temperature of 70°F (21°C). Allow for ambient temperature range at time of fabrication.
   2. Formed MCM panel lines, breaks and angles to be sharp and true, with surfaces that are free from warp or buckle.
   3. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.

B. Fabrication Tolerances: Shop-fabricate panels to sizes and joint configurations indicated on drawings.

   1. Width: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)
   2. Length: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)
   3. Squareness: +/- 0.079 inch (+/- 2mm) @ 70°F (21°C)

C. System Type

   1. Wet System
      a. The system must provide a wet seal (caulked) panel joint and must feature provisions to drain to the exterior face of the wall any leakage of water at joints and any condensation that may occur within the wall cavity as tested per AAMA 501. The sealant type shall be as specified in Section 07900 and with foamed type backer rod as indicated on architectural drawings.

D. Attachment System Components

   1. Formed from extruded aluminum as indicated on Contract Drawings to meet the specified design loads and system test performance according to each MCM System Fabricator’s design. Galvanized cold formed steel clips or staggered aluminum angles are not acceptable for panel to panel attachment.
   2. Panel stiffeners, as required, shall be positively engaged in the perimeter extrusion or mechanically fastened to the perimeter extrusion and *shall* be secured to the rear face of the

composite panel with silicone or high-strength double-sided bonding tape of sufficient size and strength to maintain panel's specified deflection under load. Structural calculations shall be provided to show the adequacy of this connection to resist the applied loads. Galvanized steel and MCM are not to be used as stiffener elements. Only panel stiffeners composed of extruded aluminum or 300 Series stainless steel shapes shall be adequate.

PART 3 – EXECUTION

3.01 MCM FABRICATOR/INSTALLER INSTRUCTIONS

Compliance: Comply with Manufacturer's product data, including product technical bulletins and product packaging instructions.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that conditions of substrates previously installed under other sections are acceptable for the MCM system installation. Documentation should be provided indicating any conditions detrimental to the performance of the MCM System.

3.03 PREPARATION

A. Miscellaneous Framing: Install miscellaneous MCM system support members and anchorage according to MCM System written instructions and drawings supplied by the MCM System Fabricator.

B. If required per project conditions, field measurements of the site condition are to be taken prior to beginning fabrication work and notification of any material modifications and resulting schedule adjustment shall be formally documented.

3.04 INSTALLATION

A. General:

1. Install the MCM system plumb, level and true in compliance with MCM System fabricator's recommendations.
2. Anchor the MCM system securely in place in accordance with Fabricator's approved shop drawings.
3. Comply with the MCM System Fabricator's instructions for installation of concealed fasteners and with provisions of Section 07 92 00 for installation of joint sealants.
4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet (6.4mm in 6.1m), noncumulative.
5. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts which require alteration to shop for modification, if possible, or for replacement with new parts.
6. Separate contact of dissimilar metals with bituminous paint, approved plastic shims, or other approved methods as defined within the Aluminum Design Manual (ASD). Use gasketed or approved coated fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

B. Related Products Installation Requirements: Refer to other sections in Related Sections paragraph herein for installation of related products.

3.05 FIELD QUALITY REQUIREMENTS

A. Field Quality Control: When required by contract, mock up shall be constructed and tested at the expense of the General Contractor, conduct water-spray test on the mock-up of the MCM System, testing for water penetration according to AAMA 501.2.

B. Testing Agency: the Owner shall engage a qualified testing agency top perform tests and inspections.

3.06 ADJUSTING and Cleaning

A. Adjusting:

1. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.
2. Removal of panels damaged by other trades shall be the responsibility of the General Contractor.
3. Repair components of the MCM system with minor damage such that repairs are not discernible at a distance of 10 feet (3m) from the surface at a 90° angle per AAMA 2605.
4. Remove and replace components of the MCM system damaged beyond repair.
5. Remove protective film immediately after installation of MCM and immediately prior to completion of the MCM system work. Masking intentionally left in place after panel installation on an elevation at the direction of the General Contractor, shall become the responsibility of the General Contractor.
6. Any additional protection, after installation, shall be the responsibility of the General Contractor.
7. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.
8. Remove from project site damaged MCM panels, protective film and other debris attributable to work of this section.

B. Cleaning:

1. Final cleaning shall not be part of the work of this section.

END OF SECTION

SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal soffit panels.

B. Delegated Design: Design of metal soffit panel system, including support framing, anchorage, fasteners, and verification of structural performance requirements and venting requirements.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference TBD

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

D. Delegated-Design Submittal: For metal soffit panels indicated to comply with delegated design requirements, including:
   1. Design calculations signed and sealed by a qualified professional engineer licensed in the jurisdiction of the Project.
   2. Analysis data to demonstrate compliance with performance requirements, including wind loads, deflection limits, and thermal movement.
   3. Details of panel anchorage, furring/support system, and interface with adjacent construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592 and per drawings:

1. Serviceability Requirements: No oil canning, vibration, or fluttering under design wind pressure.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 180 deg F (100 deg C) material surface variation.

E. Provide ventilation per SMACNA recommendations and guidelines for Soffit venting.

2.2 METAL SOFFIT PANELS

A. V-Groove-Profile Metal Soffit Panels.
1. Manufacturers and Products:
a. PAC-CLAD – Type H
i. V Groove

ii. 1” x 12”
iii. Flush wall panels
iv. Precision Series Box Rib with 1 Pencil Rib
v. Finish: From manufacturer’s full range of colors

B. Aluminum Plank Soffit Panels (Longboard):
1. Manufacturer: Longboard

2. Product Type:
a. Type F (Refer to Drawings)
b. V Groove Profile
c. Vented, Perforated Planks
d. Application: Exterior
e. Finish: From manufacturer’s full range of colors

3. Material: Extruded aluminum alloy 6063 T5 or T6.

4. Finish: AAMA 2605-compliant powder coating or anodized finish.

5. Panel Dimensions: As indicated on drawings or approved shop drawings.

6. Mounting: Use manufacturer’s proprietary concealed fastener system.

2.3 ACCESSORIES

A. Provide factory-formed flashings, trim, and accessories required for complete installation.

B. Fasteners: Corrosion-resistant, self-tapping stainless steel screws with EPDM washers, concealed where possible.

C. Sealants: As recommended by panel manufacturer, compatible with panel materials and adjacent substrates.

2.4 UNDERLAYMENT

A. Self-adhering, high-temperature modified bituminous membrane, minimum 40 mils thick and as required for this location.

B. Compliant with ASTM D1970.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 METAL PANEL INSTALLATION

A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

E. Coordinate with adjacent materials i.e. curtain walls, soffit vents and seatlant joints.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074293

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
2. Roof insulation.
3. Cover board.
4. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking, and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
5. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site .

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing or other approved testing showing compliance with IBC Code.
2. Provide information indicating sole sourcing. If other manufacturer’s and products are acceptable to roofing manufacturer as part of their warranted system include such materials and data with product submittal along with manufacturer’s written acceptance letter stating material use is acceptable and does not affect performance and warranty.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
5. Crickets, saddles, and tapered edge strips, including slopes.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations. Confirm patterns as listed in Part 3 and modify as required by manufacturer and installation method for project conditions and wind loads indicated for Project in coordination with applicable codes and design requirement indicated in structural drawings.
7. Tie-in with adjoining air barrier.
8. Provide “End of Day’s work” or “night” seal details to show how section of roof work are to be sealed from moisture infiltration to completed areas.

C. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer .

B. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Evaluation Reports: For components of membrane roofing system, from ICC-ES.

D. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. If a subcontractor is utilized for installation, the subcontracted installer must possess manufacturer's certification.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
   a. Warranty shall be considered "edge-to-edge" inclusive of all trim and accessories.
2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746/D 3746M, ASTM D 4272/D 4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): Per Structural; or as engineered by roofing manufacturer for the project conditions .
2. Zone 2 (Roof Area Perimeter): Per Structural; or as engineered by roofing manufacturer for the project conditions .
   a. Location: From roof edge to Specified dimensions inside roof edge.
3. Zone 3 (Roof Area Corners): Per Structural; or as engineered by roofing manufacturer for the project conditions .
   a. Location: Specified dimensions in each direction from each building corner.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

B. Subject to compliance with the project requirements, provide products by one of the following:

1. Johns Manville

2. Soprema

2.3 BASE SHEET MATERIALS

A. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D 6164/D 6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for cold adhesive application method.

2.4 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET

A. Granule-Surfaced Roofing Cap Sheet: ASTM D 6164/D 6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White .

2.5 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 4601/D 4601M, Type I , asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Granule-Surfaced Flashing Sheet: ASTM D 6164/D 6164M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric , granule surfaced, suitable for application method specified, and as follows:

1. Granule Color: White .

C. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.6 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Roof Vents: As recommended by roof membrane manufacturer.

1. Size: Not less than4-inch diameter.

D. Sheathing Paper (for wood decks): Red-rosin type, minimum 3 lb/100 sq. ft..

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required by roofing system manufacturer for application.

G. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

H. Fasteners: Factory-coated steel fasteners and metal insulation plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

I. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve; color to match roof membrane.

J. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

K. Roofing Membrane Adhesive: SBS modified bitumen membrane adhesive for use with sanded base ply and granule surfaced cap sheet membranes. Manufacturer's approved membrane adhesive meeting or exceeding ASTM D3019 Type III. VOC Content 250 g/L or less/.

L. Asphalt Primer: Manufacturer's approved asphalt primer meeting ASTM D41 Type I.

2.7 SUBSTRATE/COVER BOARDS

A. Cover Board: Mineral-fortified asphaltic core reinforced with asphalt-saturated glass mat.

1. Products: Subject to compliance with the project requirements, provide:
   a. Soprema: Sopraboard - 1/4"
   b. IKO
   c. Blue Ridge

2.8 ROOF INSULATION

A. General: Preformed roof insulation boards, manufactured or approved by roof membrane manufacturer,.

B. Polyisocyanurate Board Insulation: ASTM C 1289 Type II Class I, felt or glass-fiber mat facer on both major surfaces.

1. Thickness:
   a. 4-1/2 inches minimum unless otherwise indicated on drawings. Provide in multiple layers, staggered in largest size permissible. 2.5" Base Layer with 2" Top Layer.

C. Tapered Crickets: Provide factory-tapered insulation boards.

1. Material: Match roof insulation .
2. Minimum Thickness: 1/2 inch.
3. Slope:
   a. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.9 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry."

1. Note: The owner will not accept expanded "Perlite" insulation or similar eave or tapered insulation or cants. All cants shall be treated wood. All tapered board shall be polyiso.

2.10 WALKWAYS

A. Walkway Cap-Sheet Strips: ASTM D 6164/D 6164M, Type I or II, Grade G, SBS-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); granule surfaced; suitable for application method specified, and as follows:

1. Size: 36 by 60 inches .
2. Granule Color: White .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
5. Provide information in daily field reports that checks and documents moisture content of the roofing substrate. Preferable method is by RH probe. Plastic sheet method or electronic concrete meter may also be used for this Project.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.

1. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSULATION AND COVER BOARD INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F.

1. Note: The owner will not accept Perlite or similar expanded board/cellulose insulation cants. All cants shall be treated wood.

D. Installation Over Metal Decking:

1. Fasten base layer, top layer, Crickets and cover board to deck specified insulation fasteners and plates. Evenly distribute fasteners as required by the board manufacturer’s published requirements.
2. Fasten insulation to meet specified wind uplift pressure requirements and warranty requirements.
3. Minimum Fastening requirement: Coordinate fastening patterns with Part 1 and modify as needed.
    1. Field Zone 1 16 fasteners per 4x8 board
    2. Field Zone 1 16 fasteners per 4x8 board
    3. Perimeter Zone 2 24 fasteners per 4x8 board
    4. Corner Zone 3 32 fasteners per 4x8 board

4. For insulation/cover board located partially within the defined perimeter and or corners, nstall fastening for the entire board as specified herein.

3.5 INSULATION AND COVER BOARD SYSTEM APPLICATION

A. Follow insulation system component product data sheets, published general requirements and approvals.

B. Install all insulation system components on clean, dry, uniform, and properly prepared substrates.

C. All Insulation system boards shall be carefully installed and fitted against adjoining sheets to form tight joints.

D. Insulation system boards that must be cut to fit shall be saw cut or knife cut in a straight line, not broken. Chalk lines shall be used to cut insulation components. Uneven or broken edges shall not be accepted. Remove dust and debris that develops during cutting operations.

E. Stagger successive layers of insulation 12 in vertically and laterally to ensure board joints do not coincide with joints from the layers above and below.

F. Crickets, saddles, and tapered edge strips shall be installed before installing cover boards.

G. Install tapered insulation, saddles, and crickets as required to ensure positive slope for complete roof drainage.

H. Cover boards shall be installed to fit tight against adjacent boards. When required by the cover board manufacturer a uniform gap shall be provided between cover boards using a uniform guide placed between board joints to form a gap between all boards during installation.

I. The finished insulation system surface shall be tight to, and flush with, adjacent substrates to form a satisfactory substrate to install specified roof membrane and flashings.

J. Install specified cants where required for membrane flashing transitions.

3.6 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Where roof slope exceeds 1/2 inch per 12 inches , install roofing membrane sheets parallel with slope.

D. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.

2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.7 MEMBRANE ADHESIVE APPLICATION

A. The ambient temperature shall be above 50 degrees and the adhesive temperature shall be a minimum of 70 degrees at the point of membrane application.

B. To ensure the adhesive is applied at 70 degrees during cold weather drums and 5 gallon pails shall be stored in heated areas. Drums and 5 gallon pails exposed to cold temperature on the roof shall be provided with heaters when necessary to ensure the minimum application temperature is maintained.

C. Priming substrates is optional when solvent based membrane adhesives are used. Primer may be applied to reduce adhesive consumption rates for some absorptive surfaces.

D. Membrane adhesive shall be applied using 3/16 – 3/8 inch notched squeegee, brush, or spray equipment.

E. Apply adhesive to clean, dry, and prepared compatible substrates as required to ensure full adhesion.

F. Follow the adhesive product data sheet requirements for application rates.

G. Apply a uniform application of membrane adhesive at the application rate published by the product data sheet.

H. Apply 1-1/2 – 2-1/2 gallons per square between membrane plies. The application rate is 3 to 4 gallons per square over absorptive substrates and over granule surfaces. Refer to manufacturer's product data sheet and adjust application rate based upon surface conditions.

I. Install SBS membrane ply before the adhesive begins to skim over. Once adhesive skims over, the membrane ply will not adhere.

3.8 SBS-MODIFIED COLD ADHESIVE MEMBRANE INSTALLATION

A. Follow material product data sheets and published general requirements for installation instructions.

B. Ensure environmental conditions are satisfactory and will remain satisfactory during the application o the membrane adhesive and membrane plies.

C. Unroll membrane onto the roof surface and allow the membrane to relax prior to installing the membrane.

D. Re-roll the membrane in order for the plies to be rolled into the adhesive while ensuring the specified side and end laps are maintained.

E. Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back water laps.

F. Cut rolls to working lengths and widths to conform to roof conditions and lay out to always work to a selvage edge.

G. Ensure all roofing and flashing substrates are prepared as necessary, and all substrates are acceptable to receive the specified adhesive and membrane.

H. Install the specified membrane adhesive ahead of the membrane application. Do not allow the adhesive to skim over before the membrane is applied into the adhesive. The membrane will not adhere where the adhesive has skimmed over.

I. Where laps are adhered using membrane adhesive, apply sufficient adhesive coverage to ensure 1/8 to ¼ inch bleedout is present at all laps.

J. Once set in place, ensure specified side-laps and end-laps are maintained.

K. At the end laps cut a 45 degree dog ear away from the selvage edge for all T-joints.

L. For low slope areas ¼ inch per foot, or where otherwise specified/required leave all membrane side and end laps dry to hot air weld or torch all laps water-tight. Embed granules, where present, when heat welding sheets.

M. Use a follow tool, weighted roller or broom the leading edge of the membrane to the substrate, working forward and outward as necessary to remove wrinkles. Avoid walking over the membrane during application.

N. Each day, physically inspect all side and end laps and ensure the membrane is sealed water-tight. Where necessary use a torch or hot air welder and a clean trowel to ensure all laps are fully sealed.

O. Inspect the installation each day to ensure the plies are fully adhered. Repair all voids, wrinkles, open laps, and all other deficiencies.

P. Offset the cap sheet side and end laps away from the base ply laps so that cap sheet laps are not located within 18 inches of the base ply laps.

Q. Immediately broadcast matching granules into adhesive bleed-out at cap sheet laps or otherwise treat bitumen bleed-out once adhesive has dried and cured.

3.9 FLASHING APPLICATION HEAT WELDED

A. Refer to SBS manufacturer’s membrane application instructions, flashing detail drawings, and follow product data sheets and other published requirements for installation instructions. Refer to manufacturer’s membrane flashing detail drawings.

B. The contractor is responsible for project safety. Refer to NRCA CERTA recommendations and building owner requirements for hot work operations.

C. Where required to seal substrates for fire safety, install specified adhered, self-adhered or fastened backer ply to the substrate. Ensure backer-ply covers and seals all substrates requiring protection from exposure to torch operations.

D. Ensure all flashing substrates that require primer are primed, and the primer is fully dry.

E. Unroll the flashing base ply and flashing cap sheet onto the roof surface to their complete length. Once relaxed, cut the membrane to the required working lengths to accommodate the flashing height, cants, and the required over-lap onto the horizontal roof surface.

F. Cut the flashing membrane from the end of the roll to always install flashings to the side-lap line or selvage edge line.

G. Lay out the flashing base ply and flashing Cap Sheet to offset all side-laps a minimum of 12 inches so that side-laps are never aligned on top of the ply beneath. Shingle the flashing ply laps to prevent back-water laps.

H. Install non-combustible cant strips at transitions where required.

I. Ensure correct membrane and flashing sequencing to achieve redundant, multi-ply, watertight flashings.

J. ROOF MEMBRANE BASE PLY:

1. Before installing flashings, install the roof membrane base ply in the horizontal field of the roof, and extend the base ply up to the top of the cant, where present, at roof terminations, transitions, and penetrations.

K. FLASHING BASE PLY:

1. Install the flashing base ply starting at the top leading edge of the vertical flashing substrate, down over the cant and onto the horizontal surface of the roof a minimum of 3 inches beyond the of base of the cant onto the roof. Cut the base ply at corners to form 3-inch side-laps. Install gussets to seal corner transitions.
2. Install one or more flashing base ply(s) at all roof terminations, transitions, and penetrations.

L. ROOF MEMBRANE CAP SHEET:

1. Install the roof membrane Cap Sheet in the horizontal field of the roof over the flashing base ply up to the roof termination, transition, or penetration, and up to the top of cants where present.
2. Using a chalk line, mark a line on the membrane cap sheet a minimum of 4 inches from the base of the cant onto the roof. Where granules are present, embed the cap sheet granules using a torch and trowel or granule embedder to prepare the surface to receive the flashing cap sheet.

M. FLASHING CAP SHEET:

1. Install the flashing Cap Sheet starting at the top leading edge on the vertical substrate, over the cant and onto the roof surface 4 inches from the base of the cant onto the roof.

2. Install the flashing Cap Sheet to ensure a minimum two (2) ply flashing system is present at all roof terminations, transitions, and penetrations.

N. During the membrane and flashing installation, ensure all plies are completely adhered into place, with no bridging, voids, or openings. Ensure bitumen or flashing cement bleed-out is present at all flashing side and end-laps.

O. Use a damp sponge float or damp rag to press-in the heat-welded flashing plies during installation.

P. Where sufficient bitumen bleed-out is not present, and for all self-adhered plies, apply specified gun-grade sealant or mastic to seal the membrane termination along all roof terminations, transitions, and penetrations. These include gravel stop edge metal, pipe penetrations, along the top edge of curb and wall flashing, and all other flashing terminations where necessary to seal flashings watertight.

Q. Fasten the top leading edge of the flashing 8 in on-centers with appropriate 1 in metal cap nails or other specified fasteners and plates. Seal fastener penetrations watertight using specified sealant or mastic.

R. Manufacturer's liquid-applied, reinforced flashing systems shall be installed where conditions are not favorable to install SBS modified bitumen flashings. Such conditions include irregular shapes penetrating roof surfaces (I-beams), confined areas and low flashing heights. Manufacturer's liquid-applied, reinforced flashing systems are recommended in lieu of pitch pans and lead pipe flashings.

3.10 WALKWAY INSTALLATION

A. Walkway Cap Sheet Strips: Install walkway cap sheet strips over roofing membrane, using same application method as used for roofing cap sheet.

1. Install walkways strips at the following locations:
   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Top and bottom of each roof access ladder.
   e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
   f. Locations indicated on Drawings.
   g. As required by roof membrane manufacturer's warranty requirements.
2. Provide 3-inch clearance between adjoining strips.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests: REVISION 1 - ASI #4 - 09-25-2024 Perform one of the following tests noted in items 3 or 4 below to determine if there are any moisture issues or leaks. Before performing such testing provide costs associated with each test to the Owner and gain Owner direction in writing prior to engaging and performing such testing.

1. Visually inspect roofing system by walking roof after any rain events during construction and after completion of an individual roof area to verify that there is no ponding. Note any such areas by photograph and written notes and diagrams and repair to eliminate such ponding.
2. Infrared Thermography: Testing agency shall survey entire roof area using infrared color thermography according to ASTM C 1153.
    a. Perform tests before overlying construction is placed.
    b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing, or by nuclear hydrogen detection testing.
    c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
        1) Cost of retesting is Contractor's responsibility.
    d. Testing agency shall prepare survey report of initial scan indicating locations of entrapped moisture if any.
3. Electrical Capacitance/Impedance Testing: Testing agency shall survey entire roof area for entrapped water within roof assembly according to ASTM D 7954/D 7954M.
    a. Perform tests before overlying construction is placed.
    b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
        1) Cost of retesting is Contractor's responsibility.
    c. Testing agency shall prepare survey report indicating locations of entrapped moisture, if any.
4. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

C. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

1. Determine approximate quantities of components within roofing membrane according to ASTM D 3617/D 3617M.
2. Examine test specimens for interply voids according to ASTM D 3617/D 3617M and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

F. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Formed steep-slope roof sheet metal fabrications.
4. Formed equipment support flashing.
5. Formed overhead-piping safety pans.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
3. Section 079500 "Expansion Control" for manufactured sheet metal expansion-joint covers.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
2. Provide test data indicating compliance with SPRI ES-1, RE1, RE2, and RE3, as applicable to the Project, for uplift resistance criteria of edge metal(s) meeting conditions of the Project. May be indicated in separate product information submittal or indicated in Shop Drawings.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.
13. Include test data indicating compliance with SPRI ES-1, RE1, RE2, and RE3 as applicable to the Project, for uplift resistance crieterir of edge metal(s) meeting conditions of the Project.

C. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 incheslong by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 incheslong and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.
2. SPRI ES-1 tests RE 2 and RE-3.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).

C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat.

2. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inchwide and 1/8 inchthick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. High-Temperature Self-Adhered Membrane Flashings.

1. Where required in the drawings for use under metal copings, metal panels and other sheet metal flashings subject to direct sunlight and/or high temperatures provide 40 mil thick product capable of handling such high temperatures. With product provide data indicating product is acceptable for use for such areas and compatible with substrate it is being applied to.
   a. Atlas WeatherMaster Pro-Grade Ice and Water Underlayment.
   b. Grace Ice and Water Shield HT.
   c. Other approved equal.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feeton slope and location lines indicated on Drawings and within 1/8-inchoffset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inchdeep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

F. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock

gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

1. Gutter Profile: Style A according to cited sheet metal standard.
2. Expansion Joints: Butt type with cover plate.
3. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.
4. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
    a. Galvanized Steel: 0.022 inch thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: Fig 1-35A according to SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:
    a. Galvanized Steel: 0.022 inch thick.

C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

E. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Stainless Steel: 0.019 inch thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate from the Following Materials:
    a. Galvanized Steel: 0.028 inch thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of

external leg and drill elongated holes for fasteners on interior leg. Miter corners (welded or continuous one piece fabrication), fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate from the Following Materials:
   a. Galvanized Steel: 0.040 inch thick.

C. Roof Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.

1. Galvanized Steel: 0.034 inch thick.

D. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

H. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Valley Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

C. Drip Edges: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Galvanized Steel: 0.040 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inchesapart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inchesof corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inchdeep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inchinto sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in zinc where necessary for strength.

3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous cleat.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
4. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
6. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with 1-1/2-inchtelescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 incheso.c.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system.

D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.

E. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

F. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inchbelow scupper discharge.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers or as otherwise required to comply with ANSI/SPRI/ES-1 for the design conditions indicated.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

1. Anchor interior leg of coping with washers and screw continuous cleat(s) anchored to substrate fasteners as required to comply with ANSI/SPRI/ES-1 for the design conditions indicated.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inchesover base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inchesover base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feeton slope and location lines indicated on Drawings and within 1/8-inchoffset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured roof specialties, including copings, fascias, and penetration flashing.

1.2 RELATED REQUIREMENTS

A. Section 07 52 16 Styrene-Butadiene - Styrene (SBS Modified Bituminous Membrane Roofing

B. Section 07 62 00 - Sheet Metal Flashing and Trim

C. Section 07 72 00 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

D. Section 07 90 00- Joint Sealers.

1.3 REFERENCE STANDARDS

A. ANSI/SPRI/FM 4435/ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011.

B. NRCA (RM) - The NRCA Roofing Manual; 2017.

C. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Specialty Penetration Flashings:
   1. York Manufacturing, Inc.: www.yorkmfg.com.
   2. Roof Products & Systems Corp.: www.rpscurbs.com.
   3. Portals Plus, Inc.: www.portalsplus.com.
   4. Pate Company: www.patecurbs.com.

2.2 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable code.

B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.

1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 RE-3 to positive and negative design wind pressure as defined by applicable code.

C. Control and Expantion Joint Covers: Composite construction of flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 5 inches. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

D. Specialty Penetration Flashings: Preformed EPDM pipe and penetration seals designed for waterproof seal of individual, and clustered, roof penetrations.
1. Provide size and configuration required by each specific condition to provide maximum height above roof surface to the stainless steel clamping ring.
2. Where a preformed flashing boot will not slide over a penetrating item, provide "Retrofit Flashing" by Portals Plus Inc. designed to wrap around the item and closed with a weatherproof seal.
3. Where a metal base is required by the roofing membrane manufacturer for tie-in to the roof membrane, provide one of the following:
   a. Alumi-Flash System manufactured by Portals Plus Inc.
   b. Alumi Flash manufactured by Roof Products & Systems Corp.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

C. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

D. Provide weathertight installation.

END OF SECTION

SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-finished aluminum gutters and downspouts.

B. Precast concrete splash pads.

1.2 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Conform to SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.

B. Conform to applicable code for size and method of rain water discharge.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures

B. Product Data: Provide data on prefabricated components.

C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

D. Samples: Submit two samples, 12 inch long illustrating component design, finish, color, and configuration.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209 (ASTM B209M); 0.032 inch thick.

1. Finish: Plain, shop pre-coated with modified silicone coating.
2. Color: To match Architect's sample.

2.2 COMPONENTS

A. Gutters: SMACNA rectangular style profile.

B. Downspouts: SMACNA Rectangular profile.

C. Anchors and Supports: Profiled to suit gutters and downspouts.
   1. Anchoring Devices: In accordance with SMACNA requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

D. Fasteners: Galvanized steel, with soft neoprene washers.

2.3 ACCESSORIES

A. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

2.4 FABRICATION

A. Form gutters and downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.5 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; custom color to match approved sample.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that surfaces are ready to receive work.

3.2 PREPARATION

A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.

C. Slope gutters 1 unit in 96 units along entire length.

D. Set splash pans under downspouts.

END OF SECTION

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof hatches, manual and automatic operation, including smoke vents.

1.2 RELATED REQUIREMENTS

A. Section 07 52 00 - Modified Bituminous Membrane Roofing.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashing.

C. Section 09 96 00 High Performance Coatings

D. Division 26 - Electrical: Fire alarm interconnection.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Guarding floor and wall openings and holes; current edition.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

E. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2015.

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

B. Lifeline Design Data: Two copies of comprehensive design calculations for lifeline, connection and anchorage devices. Review of design calculations shall not alter manufacturer's design responsibility for system and connectors.

C. Manufacturer's Certification: Certify that walkway and railings have been designed to meet the design criteria of the specified code; include all conditions or limitations of the design necessary to achieve the necessary strength for the loading specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS - LIFELINE

A. Design, engineer, construct and load-test system.

B. Provide supports, and anchors designed and constructed to suit building configuration and in accordance with the contract documents and applicable regulations and codes.

C. Design all anchor components to provide adequate attachment to building and to suit current maintenance practices; ensure compatibility with industry standard equipment.

D. Design calculations performed and certified by a professional engineer licensed in the State where the project is located for structural adequacy of system. Coordinate structural calculations with submittals.

2.2 PERFORMANCE REQUIREMENTS - LIFELINE

A. Safety Factor: Design primary support equipment to sustain without failure at least four times the maximum static working load applied or transmitted to the components. In no case shall the combined live and dead loads be calculated at less than 1000 pounds.

B. Base plates and sockets: Total safety factor of 4 to 1 against the overturning moment through 360-degree rotation.

C. Wire rope rated capacity: To resist the combined live and dead load with a factor of safety of 6 to 1 against yield.

D. Fall Arrest Safety Anchors: Designed to a maximum fall arresting force of typically 1800 lbs. when wearing a body harness with a safety factor of 2 without any permanent deformation and to 5000 lbs. against fracture or detachment.

2.3 ROOF HATCHES

A. Manufacturers - Roof Hatches:
   1. Bilco Company; Type F (equipment access, 4 ft square): www.bilco.com.
   2. Milcor by Commercial Products Group of Hart & Cooley, Inc; Model RD-4x4 EE: www.milcorinc.com.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Roof Hatches and Smoke Vents, General: Factory-assembled steel frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. Mounting: Provide frames and curbs suitable for mounting on flat roof deck.
   3. For Ships Ladder Access: Single leaf; 48 by 48 inches.

C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gage, 0.0907 inch thick.
   2. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
   3. Curb Height: 12 inches from finished surface of roof, minimum.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Mill finished aluminum; outer cover 11 gage, 0.0907 inch thick, liner 0.04 inch thick.

3. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
4. Gasket: Neoprene, continuous around cover perimeter.

E. Ladder Safety Post: Tubular steel telescopic post that automatically locks when fully extended through hatchway. Stainless steel spring balancing mechanism to provide controlled upward and downward operation. Release lever to disengage the post to allow return to lowered position. Adjustable mounting brackets to fit ladder rung spacing up to 14-inches on center; clamp brackets to accommodate ladder rungs up to 1-3/4-inch in diameter.

F. Safety Railing System: Manufacturer's standard accessory safety rail system mounted directly to curb.
1. Comply with 29 CFR 1910.23, with a safety factor of two.
2. Posts and Rails: Aluminum tube.
3. Finish: Manufacturer's standard, factory applied finish.
4. Manufacturers:
a. Bilco Company: www.bilco.com/sle.

G. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
2. Hinges: Manufacturer’s recommended type.
3. Hold open arm with vinyl-coated handle for manual release.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior.
6. Locking: Padlock hasp on interior.
7. All hardware to be stainless steel

2.4 HORIZONTAL CABLE LIFELINES

A. Manufacturers:
1. Pro-Bel Group: www.pro-bel.ca.
2. Guardian Fall Protection: www.guardianfall.com.
3. Capital Safety: www.capitalsafety.com.
4. XS Platforms: www.xsplatforms.com.
5. 01 25 00 Substitution Procedures and Substituion Request Form

B. Horizontal Lifeline System: Hands-free cable type.
1. Cable: 5/16 inch or 1/2 inch diameter Type 316 stainless steel with minimum breaking strength of 19,125 pounds, complete with permanently swedged cable ends.
2. Data Plate: At cable system entry points, provide prominently displayed non-corrodible data plate clearly stating Maximum Service Capacity and Number of Users.
3. Intermediate Support Brackets: Multi-position Type 316 stainless steel secured using 1/2 inch diameter fasteners.
4. Entry/Exit Brackets: Type 316 stainless steel.
5. Connector: Type 316 stainless steel, with automatic connector bypass feature for continuous hands-free operation, and detachability feature for window cleaning operations.
6. Tensioner Units: Type 316 stainless steel with polished finish.
7. Harness: Manufacturer's standard hands-free full body harness and lanyard complete with shock absorber.
8. Accessories: Manufacturers standard corner units as required.
9. Product: Hands-Free Horizontal Lifeline System manufactured by Pro-Bel Group: www.pro-bel.ca

C. Roof Anchors:
1. Safety and Tie-Back Anchors: U-bar type; ASTM A666 Type 304 stainless steel with yield strength of 36 Ksi, of not less than 3/4 inch diameter material with 1-1/2 inch eye opening.

2. Piers: ASTM A500/A500M seamless round steel tubing with yield strength of 50 Ksi, hot dipped galvanized to ASTM A123/A123M, with wall thickness to suit application.
3. Base Plates and Other Sections: ASTM A572/A572M galvanized mild steel as above with yield strength of 44 Ksi. Thickness and securement to suit application.
4. Miscellaneous Bolts, Nuts and Washers: ASTM A307 with yield strength of 44 Ksi, hot dipped galvanized to ASTM A123/A123M or Type 304 stainless steel with yield strength of 35 Ksi.
5. Flashing for Roof Mounted Supports and Anchors in Bituminous Roofing: Seamless spun aluminum flashing, ASTM B221, Type 6061-T6 alloy with deck flange flashed in to NRCA ML104 recommendations.
6. Product: Roof Anchors manufactured by Pro-Bel Group: www.pro-bel.ca

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Supply items required to be cast into concrete with setting templates, to appropriate Sections.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

B. Coordinate with installation of roofing system and related flashings.

C. Apply bituminous paint on metal surfaces of roof hatches to be in contact with cementitious materials and dissimilar metals.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 76 13 - ROOF PAVERS AND BALLAST MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pavers for roofing ballast.

1.2 RELATED REQUIREMENTS

A. Section 07 52 00 - Modified Bituminous Membrane Roofing.

1.3 REFERENCE STANDARDS

A. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.

B. ASTM C293/C293M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading); 2016.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Selection Samples: Two complete sets of color chips representing manufacturer's full range of colors and patterns available from regional plant.

C. Verification Samples: Two samples, minimum size 12 inches square, representing actual product to be supplied from regional plant, color, and patterns.

D. Specimen warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging, with labels intact, until ready for installation.

B. Store products off the ground; if stored on the roof, do not exceed structural capacity of deck.

1.6 WARRANTY

A. See Section 01 77 00 - Closeout Proceduresfor additional warranty requirements.

B. Ballast Pavers: Provide manufacturer's 20-year limited material warranty.

C. Ballast Pavers: Provide manufacturer's limited wind uplift warranty for 3 years after Substantial Completion.

1.7 MAINTENANCE TOOLS

A. Paver Lifter: Provide one Probst Slab Grabber; deliver to Owner at location directed; provide 3-year warranty.

PART 2 PRODUCTS

2.1 ROOF DECK APPLICATIONS (OCCASIONAL FOOT TRAFFIC ONLY)

A. Ballast Pavers: Precast concrete units with integral color and tooled joint pattern.
   1. Basis of Design: Tectura Lok Down pedestal system manufactured by Wausau Tile, Inc.
   2. Products:
      a. Pavers on Pedestals manufactured by Hanover Architectural Products: www.hanoverpavers.com.
      b. Roofblok Ballast Systems manufactured by Roofscape Architectural Pavers: www.roofblok.com.
   3. Size:
      a. 24 by 48 inches
      b. 30 by 30 inches
   4. Thickness: 2-3/4 inches.
   5. Compressive Strength: 7000 psi, minimum, air entrained mix, after 28 days cure, when tested in accordance with ASTM C140/C140M.
   6. Flexural Strength: 400 psi, when tested in accordance with ASTM C293/C293M.
   7. Density: 145 pcf, maximum.
   8. Water Absorption: 5 percent (nominal), when tested in accordance with ASTM C140/C140M.
   9. Color: As selected.

B. Protection Mat: Nonwoven polyester.

C. Mechanical Clips: Galvanized sheet metal.

D. Adjustable Height Paver Pedestals: High impact styrene adjustable paver pedestals telescope from 2 inch to 5-1/2 inch, tilt to accommodate sub-surface slope and create a smooth, uniform, paver surface.
   1. Provide sizes and height required to make top surface of pavers a single plane without abrupt changes in surface plane.
   2. Product: Terra-Tab manufactured by Tectura Designs0

E. Perimeter Attachments: Products made by one of the following:
   1. Metal Era: www.metalera.com.
   2. W.P. Hickman: www.wphickman.com.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until all roofing or waterproofing work is completed, including work penetrating waterproof plane.

3.2 PREPARATION

A. Clean roof surfaces thoroughly prior to installation.

B. Plan sequence of transporting and placing pavers to avoid damage to waterproof membrane and already installed pavers; place 3/4 inch thick plywood in traffic paths or use carts with pneumatic tires.

3.3 ROOF BALLAST

A. Install pavers on paver pedestals in accordance with manufacturer's instructions. Provide approximately 1/4 inch space between pavers to permit surface water drainage.

B. Install pavers in locations and pattern indicated on drawings.

C. Install protection mat wherever required by roof membrane manufacturer.

D. Install perimeter retainer around entire perimeter.

3.4 PROTECTION

A. Protect installed products until completion of project. Prohibit construction traffic unless adequate precautions are taken.

B. Repair or replace products damaged due to inadequate protection.

END OF SECTION

SECTION 07 81 00 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Concealed SFRM.
   2. Exposed SFRM.
   3. Exposed intumescent mastic fire-resistive coatings.

B. Related Sections include the following:
   1. Division 05 Section "Structural Steel Framing" for surface conditions required for structural steel receiving SFRM.
   2. Division 07 Section "Thermal Insulation" for fire-safing insulation.
   3. Division 07 Section "Penetration Firestopping" for fire-resistance-rated firestopping systems.
   4. Division 07 Section "Fire-Resistive Joint Systems" for fire-resistance-rated joint systems.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive material.

B. Concealed: Fire-resistive materials applied to surfaces that are concealed from view behind other construction when the Work is completed and have not been defined as exposed.

C. Exposed: Fire-resistive materials applied to surfaces that are exposed to view when the Work is completed, and that are identified as exposed on Drawings.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design SFRM thickness and application according to the hour ratings listed in Schedule, performance requirements and design criteria indicated, including comprehensive engineering analysis by a qualified professional engineer.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Structural framing plans indicating the following:
   1. Locations and types of surface preparations required before applying SFRM. Include locations for Architect’s review and approval of all locations receiving Level 3 finish as described below, 2.3 1, a.
   2. Extent of SFRM for each construction and fire-resistance rating, including the following:

      a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.

For steel joist assemblies, include applicable fire-resistance design designations, with each steel joist tested with the same maximum tensile stress as each steel joist indicated. Design designations with steel joists tested at lower maximum tensile stress than those indicated are not permitted.

b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

3. Treatment of SFRM after application.

C. Samples for Initial Selection: For each type of colored, exposed SFRM indicated.

D. Delegated Design Submittal: For installed SFRM indicated to comply with performance requirements, and design criteria including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. SFRM Schedule: Tabulated schedule of SFRM with information including, but not limited to, application areas, surface finish for exposed, and color.

F. Samples for Verification: For each type of colored, exposed SFRM, two Samples, each 4 inches square, of each color, texture, and material formulation to be applied. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

G. Product Certificates: For each type of SFRM, signed by product manufacturer.

H. Qualification Data: For Installer, manufacturer, professional engineer, and testing agency.

I. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating the following:
1. Materials have been tested for bond with substrates.
2. Materials have been verified by SFRM manufacturer to be compatible with substrate primers and coatings.
3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

J. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed SFRM.

K. Research/Evaluation Reports: For SFRM.

L. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by SFRM manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Source Limitations: Obtain SFRM through one source from a single manufacturer.

C. SFRM Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
1. SFRMs are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Testing is performed on specimens of SFRMs that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.

3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

D. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with SFRM.

E. Fire-Test-Response Characteristics: Provide SFRM with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing SFRM with appropriate markings of applicable testing and inspecting agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" acceptable to authorities having jurisdiction, for SFRM serving as direct-applied protection tested per ASTM E 119.
2. Surface-Burning Characteristics: ASTM E 84.

F. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

G. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Extent of Mockups: Approximately 100 sq. ft. of surface for each product indicated.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is **40 deg F** or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.9 COORDINATION

A. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
6. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
      b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SFRM

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Concealed Cementitious SFRM:
      a. Carboline Co., Fireproofing Products Div.; AD Southwest Type 5GP.
      b. Carboline Co., Fireproofing Products Div.; A-20 Accelerator.
      c. Grace, W. R. & Co. - Conn., Construction Products Div.; Monokote Type MK-6, MK-6/HY, and MK-6s.
      d. Grace, W. R. & Co. - Conn., Construction Products Div.; Retro-Gard.
      e. Isolatek International Corp.; Cafco 300.
      f. Isolatek International Corp.; Cafco 300 SB.

B. Material Composition: Manufacturer's standard product, as follows:
   1. Concealed Cementitious SFRM: Factory-mixed, dry formulation of gypsum or portland cement binders, additives, and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
1. Dry Density: 15 lb/cu. ft. for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
2. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605:

    a. Where the referenced fire-resistance design lists a thickness of 1 inch or more, the minimum allowable individual thickness of SFRM is the design thickness minus 0.25 inch.
    b. Where the referenced fire-resistance design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of SFRM is the greater of 0.375 inch or 75 percent of the design thickness.
    c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft..
3. Bond Strength: 150 lbf/sq. ft. minimum per ASTM E 736 based on laboratory testing of 0.75-inch minimum thickness of SFRM.
4. Compressive Strength: 5.21 lbf/sq. in. minimum per ASTM E 761. Minimum thickness of SFRM tested shall be 0.75 inch and minimum dry density shall be as specified but not less than 15 lb/cu. ft..
5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of SFRM is 0.75 inch, maximum dry density is 15 lb/cu. ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 0.
10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

2.2 EXPOSED SFRM

A. Products: Subject to compliance with requirements, provide one of the following:
1. Exposed Cementitious SFRM:

    a. Carboline Co., Fireproofing Products Div.; AD Southwest Type 5MD.
    b. Carboline Co., Fireproofing Products Div.; A-20 Accelator.
    c. Carboline Co., Fireproofing Products Div.; Pyrocrete 40.
    d. Carboline Co., Fireproofing Products Div.; Pyrocrete 240 High Yield.
    e. Carboline Co., Fireproofing Products Div.; Pyrocrete 241.
    f. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106G.
    g. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106.
    h. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106/HY.
    i. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z146.
    j. Isolatek International Corp.; Cafco 400.
    k. Isolatek International Corp.; Fendolite M-II.

B. Material Composition: Manufacturer's standard product, as follows:
1. Exposed Cementitious SFRM: Factory-mixed, dry, cement aggregate formulation; or chloride-free formulation of gypsum or portland cement binders, additives, and inorganic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
1. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method," but with an average density of not less than 22 lb/cu. ft..
2. Bond Strength: 434 lbf/sq. ft. minimum per ASTM E 736.
3. Compressive Strength: 51 lbf/sq. in. minimum per ASTM E 761.
4. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method," but with an average density of not less than 39 lb/cu. ft..
5. Bond Strength: 1000 lbf/sq. ft. minimum per ASTM E 736.
6. Compressive Strength: 300 lbf/sq. in. minimum per ASTM E 761.
7. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
8. Deflection: No cracking, spalling, or delamination per ASTM E 759.
9. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. per ASTM E 859.
11. Combustion Characteristics: Passes ASTM E 136.
12. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 0.
13. Fungal Resistance: No observed growth on specimens per ASTM G 21.
14. For exterior applications of SFRM, provide formulation listed and labeled by testing and inspecting agency acceptable to authorities having jurisdiction for surfaces exposed to exterior.

2.3 INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

A. Products: Subject to compliance with requirements, provide one of the following:
1. Fire-Resistive, Water-Based, Intumescent Mastic Coating Material:

    a. Carboline Company, Fireproofing Products Div.; Firefilm III Topcoat is required for those areas receiving color only.

        Level 3 Finish: for all or portions of exposed steel receiving intumescent coatings, provide Level 3 finish, back rolled and sanded to a smooth finish before top coated for color. Provide locations to Architect for review and approvals.

    b. Level 1 or Level 2 is sufficient for all concealed steel receiving intumescent coatings.

    c. Carboline Solvent based Intumescent ThermoSorb VOC Topcoat is optional for color only
    d. Isolatek International Corp.; Cafco SprayFilm-WB 2 Basecoat and Topseal.
    e. Isolatek International Corp.; Cafco SprayFilm-WB 3 Basecoat and topcoat recommended by manufacturer of basecoat.

B. Fire-Resistive, Intumescent Mastic Coating: Factory-mixed formulation.
1. Water-Based Formulation: Approved by manufacturer and authorities having jurisdiction and investigated for Interior General Purpose by UL.
2. Multicomponent system consisting of intumescent base coat and topcoat.

C. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with SFRM and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
   1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
   2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of SFRM per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of SFRM.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive SFRM.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of SFRM.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of intumescent mastic coating fire-resistive material. Include pins and attachment.

G. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.
   1. Product: Subject to compliance with requirements, provide Carboline TC-55 Bond sealer
   2. "Cafco Bond-Seal" by Isolatek International Corp.

H. Topcoat: Type recommended in writing by manufacturer of each SFRM for application over exposed SFRM

2.5 NATATORIUM – CONCEALED AND EXPOSED INTUMESCENT MASTIC FIRE-RESISTIVE AND HIGH-PERFORMANCE COATING SYSTEM.

A. Description:

Provide a complete, high-performance, corrosion-resistant intumescent fireproofing system suitable for use in interior humid and chlorinated natatorium environments.

System shall be by Carboline Company and shall consist of compatible primer, intumescent fireproofing, and topcoat products applied in strict accordance with manufacturer’s written instructions.

B. System Components (in order of application):
   1. Primer
      a. Product: Carboline Carbomastic 94
      b. Type: High solids, aluminum-pigmented epoxy mastic coating.
      c. Purpose: Provides corrosion-resistant base and enhances adhesion of intumescent coating to structural steel in high humidity and chlorinated atmospheres.
      d. Application: Apply to clean, prepared steel surfaces prior to application of intumescent coating.
      e. Dry Film Thickness (DFT): 4–6 mils per manufacturer’s recommendation.
      f. VOC: <340 g/L.
      g. Color: Aluminum gray.
      h. Reference Standard: SSPC-PA 1; compatible with Thermolag E100S.

2. Intumescent Fireproofing
   a. Product: Carboline *Thermolag E100S*
   b. Type: Two-component, epoxy-based, intumescent fire-resistive material (IFRM).
   c. Purpose: Provides fire-resistance rating of 1- to 3-hours (UL design dependent) for structural steel members.
   d. Application: Spray-applied or trowel-applied to achieve required thickness in accordance with UL design assemblies.
   e. Typical DFT Range: 150–700 mils, depending on required fire rating.
   f. Performance Requirements:
      - Tested in accordance with ASTM E119 / UL 263.
      - UL Listed and approved for both interior and exterior exposures.
      - Bond Strength: Minimum 150 psi (ASTM E736).
      - Hardness: >65 Shore D.
      - Thermal Expansion: Intumescent expansion factor 5–10x original thickness when exposed to fire.
   g. **Environmental Suitability:**
      - Suitable for chlorine/chloramine-rich atmospheres typical of natatorium environments.
      - High humidity and chemical exposure resistant.
      - **Color:** Off-white (field topcoated as specified).

3. TopCoat Intumescent Fireproofing
   a. Product: Carboline Carbomastic 94 (same as primer) or other Carboline-approved compatible topcoat.
   b. Purpose: Protects intumescent coating from moisture, chemicals, and abrasion while providing uniform architectural appearance.
   c. Application: Apply only after Thermolag E100S has fully cured.
   d. DFT: 4–6 mils per coat; minimum 8 mils total for humid pool environments.
   e. Color and Finish: As selected by Architect from manufacturer's full range.
   f. Optional Alternate Topcoat: Carboline ThermoSorb VOC (for aesthetic topcoat only).

C. System Performance:
   1. Fire Rating: UL Listed 1- to 3-hour protection for steel beams, columns, and joists per UL designs (e.g., UL Design No. WJ110, Y737, X777 or equivalent).
   2. Humidity/Corrosion Resistance: Complies with ASTM B117 and ISO 12944 for immersion-grade epoxy coatings; resistant to chloramine exposure.
   3. Adhesion Compatibility: Primer and topcoat fully compatible with Thermolag E100S system as tested and warranted by Carboline.
   4. Temperature Range: Continuous service –20°F to 200°F; intermittent up to 300°F.
   5. VOC Compliance: Complies with SCAQMD Rule 1113 and national VOC regulations.

D. Submittals:

   Provide the following in addition to Section 1.5 requirements:
   1. Manufacturer's system data sheet listing all components, application sequence, cure times, and UL design references.
   2. Compatibility documentation confirming primer, intumescent, and topcoat are part of a tested and approved system.
   3. Project-specific written warranty covering adhesion, corrosion, and fire-resistance performance for minimum 5 years.
   4. Certificates of Compliance verifying product suitability for humid, chlorinated environments.

E. Application Notes:
   1. All steel surfaces shall be cleaned to SSPC-SP6 (Commercial Blast) minimum prior to primer application.
   2. Primer shall be fully cured prior to application of Thermolag E100S.
   3. Intumescent coating shall be applied in multiple passes as required to achieve total DFT.

4. Final topcoat shall be applied only after full cure of Thermolag E100S, typically 7–14 days depending on temperature and humidity
5. All application work shall be performed by a Carboline-certified applicator experienced with Thermolag systems.

F. Warranty:

Provide Carboline 5-Year System Warranty covering adhesion, corrosion, and fire performance for the full coating assembly (primer, intumescent, topcoat).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Verify that concrete work on steel deck has been completed.

C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work are completed.

D. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.

B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.

C. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.

D. For exposed applications, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of SFRM. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION, GENERAL

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Apply SFRM that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.

C. Install metal lath and reinforcing fabric as required to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use, whether explicitly indicated or not. Securely attach lath and fabric to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by SFRM manufacturer. Attach accessories where indicated or required for secure attachment of lath and fabric to substrate.

D. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by SFRM manufacturer for material and application indicated.

E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.

F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.

G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply SFRM that differs in color from that of encapsulant over which it is applied.

H. Where sealers are used, apply products that are tinted to differentiate them from SFRM over which they are applied.

3.4 APPLICATION, CONCEALED SFRM

A. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed SFRM" Article.

B. Cure concealed SFRM according to product manufacturer's written recommendations.

3.5 APPLICATION, EXPOSED SFRM

A. Apply exposed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if indicated.
   1. For steel beams and bracing, provide a thickness of not less than 1 inch.
   2. For metal floor or roof decks, provide a thickness of not less than 1/2 inch.

B. Provide a uniform finish complying with description indicated for each type of material and matching Architect's sample or, if none, finish approved for field-erected mockup.

C. Apply exposed cementitious SFRM to produce one of the following finishes, as directed by Architect:
   1. Skip-troweled finish with leveled surface, smoothed-out texture, and neat edges.
   2. Smooth, troweled finish with surface markings eliminated and edges squared.

D. Apply exposed sprayed-fiber fire-resistive material to produce the following finish:
   1. Spray-textured finish.
   2. Sealer.
   3. Topcoat.

E. Cure exposed SFRM according to product manufacturer's written recommendations.

3.6 APPLICATION, INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

A. Apply intumescent mastic fire-resistive coatings in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition. Apply where indicated, and wherever application of SFRM would produce dimensional conflicts and where intumescent coating would not produce similar conflicts.

B. Apply intumescent mastic fire-resistive coating as follows:
   1. Install reinforcing fabric as required to obtain designated fire-resistance rating and where indicated.
   2. Finish: Even, spray-textured finish produced by lightly rolling flat surfaces of fire-protected members before fire-resistive material dries, to smooth out surface irregularities and to seal in surface fibers.

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspection and prepare reports:
   1. SFRM.
   2. Intumescent mastic coasting.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
   1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

C. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
   1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.
   2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
   3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
   4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.

      a. Field test SFRM that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
      b. If surfaces of structural steel receiving SFRM are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. minimum per ASTM E 736.

5. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

D. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.

E. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

3.8 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect SFRM, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.

C. Coordinate application of SFRM with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect SFRM and patch any damaged or removed areas.

D. Repair or replace work that has not successfully protected steel.

END OF SECTION 07 81 00

SECTION **07 84 13** - **PENETRATION FIRESTOPPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

B. Related Sections:
   1. Division 07 Section 07 84 46 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Not used.

C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

D. Qualification Data: For qualified Installer.

E. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
   a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
   b. Classification markings on penetration firestopping correspond to designations listed by the following:
      1) UL in its "Fire Resistance Directory."

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. A/D Fire Protection Systems Inc.
   2. Grace Construction Products.
   3. Hilti, Inc.
   4. Johns Manville.
   5. Nelson Firestop Products.
   6. NUCO Inc.
   7. Passive Fire Protection Partners.
   8. RectorSeal Corporation.
   9. Specified Technologies Inc.
   10. 3M Fire Protection Products.
   11. Tremco, Inc.; Tremco Fire Protection Systems Group.
   12. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance

rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire walls fire-barrier walls smoke-barrier walls and fire partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include floors and floor/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. Omit

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.

5. Manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.6 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestopping with No Penetrating Items:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 0001-0999.
   2. Type of Fill Materials: As required to achieve rating.

C. Firestopping for Metallic Pipes, Conduit, or Tubing:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 1001-1999.
   2. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Electrical Cables:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 3001-3999.
   2. Type of Fill Materials: As required to achieve rating.

E. Firestopping for Insulated Pipes:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 5001-5999.
   2. Type of Fill Materials: As required to achieve rating.

F. Firestopping for Miscellaneous Electrical Penetrants:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 6001-6999.
   2. Type of Fill Materials: As required to achieve rating.

G. Firestopping for Miscellaneous Mechanical Penetrants:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 7001-7999.
   2. Type of Fill Materials: As required to achieve rating.

H. Firestopping for Groupings of Penetrants:
   1. UL-Classified Systems: C-AJ-, W-L-, F-D, 8001-8999.
   2. Type of Fill Materials: As required to achieve rating.

END OF SECTION 07 84 13

SECTION 07 84 46 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Joints in or between fire-resistance-rated constructions.
   2. Joints at exterior curtain-wall/floor intersections including Perimeter fire containment at slab edges, including fire safing between floor slabs and curtain walls
   3. Joints in smoke barriers.

B. Related Sections:
   1. Division 07 Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
   1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For qualified Installer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
   1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
      a. Fire-resistive joint system products bear classification marking of qualified testing agency.
      b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
         1) UL in its "Fire Resistance Directory."

B. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
   1. Joints include those installed in or between fire-resistance-rated walls floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
   2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
   3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. A/D Fire Protection Systems Inc.
      b. CEMCO.
      c. Fire Trak Corp.
      d. Grace Construction Products.
      e. Hilti, Inc.
      f. Johns Manville.
      g. Nelson Firestop Products.
      h. NUCO Inc.
      i. Passive Fire Protection Partners.
      j. RectorSeal Corporation.
      k. Specified Technologies Inc.
      l. 3M Fire Protection Products.
      m. Tremco, Inc.; Tremco Fire Protection Systems Group.
      n. USG Corporation.

C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.

1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30 inch wg at both ambient and elevated temperatures.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. A/D Fire Protection Systems Inc.
    b. Grace Construction Products.
    c. Hilti, Inc.
    d. Johns Manville.
    e. Nelson Firestop Products.
    f. NUCO Inc.
    g. Passive Fire Protection Partners.
    h. RectorSeal Corporation.
    i. Specified Technologies Inc.
    j. 3M Fire Protection Products.
    k. Tremco, Inc.; Tremco Fire Protection Systems Group.
    l. USG Corporation.

3. **Perimeter Fire Containment**: At intersections between horizontal floor assemblies and nonrated exterior curtain walls, provide fire-resistive joint systems (fire safing insulation and sealant) tested in accordance with ASTM E2307.

D. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Provide fire-resistive joint systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Floor-to-Floor, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.
   3. W-Rating: No leakage of water at completion of water leakage testing.

C. Wall-to-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

D. Floor-to-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

E. Head-of-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

F. Bottom-of-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

G. Wall-to-Wall, Fire-Resistive Joint Systems Intended for Use as Corner Guards:
   1. Assembly Rating: 2 hours, but not less than the system being sealed.
   2. Nominal Joint Width: As indicated.

H. Perimeter Fire-Resistive Joint Systems:
   1. Integrity Rating: 2 hours.
   2. Insulation Rating: 1 hour.
   3. Linear Opening Width: As indicated, maximum

I: Perimeter Fire-Resistive Joint Systems – Fire Safing at Slab Edge and Curtain Wall

1. Location: Between horizontal concrete slabs and nonrated exterior curtain walls

2. Test Standard: ASTM E2307

3. Assembly Rating (Integrity): 2 hours

4. Insulation Rating: 1 hour

5. Linear Opening Width: As indicated on Drawings, maximum

6. Movement Capability: As tested; accommodate expected building movement

7. System Type: UL-classified perimeter fire containment system

8. Typical System Numbers (select based on tested configurations and manufacturer):
   - Hilti CW-D-1014
   - STI ASJ120-07
   - 3M CW-S-1016
   - Tremco FAS 0099

END OF SECTION 07 84 46

SECTION 079200 - JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Urethane joint sealants.
2. Mildew-resistant joint sealants.
3. Butyl joint sealants.
4. Latex joint sealants.
5. Compressible foam sealants

B. Related Requirements:

1. Section 03 30 00 Cast -In-Place Concrete for Concrete Sealants
2. Section 04 20 00 Unit Masonry
3. Section 05 40 00 Cold Formed Metal Framing for Compressible Joint Sealants
4. Section 07 84 46 fire-Resistive Joint Systems
5. Section 32, Exterior Improvements, Concrete Paving Joint Sealant for sealing joints in paved roads, parking lots, walkways, and curbing.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Provide sealant adhesion pull testing in accordance with ASTM C1521 for mock up(s).

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Bostik, Arkema
   b. Master Builders Solutions, brand of MBCC Group, a Sika Company
   c. PPG Paints: PPG Industries, Inc.
   d. Pecora Corporation
   e. Sika Corporation – Building Componants
   f. Tremco Incorporated

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. PPG Paints; PPG Industries, Inc.
   b. Sika Corporation - Building Components.
   c. The Dow Chemical Company.
   d. Tremco Incorporated.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bostik, Inc.
   b. Pecora Corporation.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Pecora Corporation.
   b. Sherwin-Williams Company (The).
   c. Tremco Incorporated.

2.6 SILICONE JOINT SEALANTS

A. Silicone Joint Sealants

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. GE Construction Sealants: Momentive Performance Materials, Inc.
   b. Pecora Corporation
   c. Sika Corporation – Building Componants
   d. The Dow Chemical Company
   e. Tremco Incorporated

2. Silicone Joint Sealants in Natatorium and adjacent areas:
   a. To be chlorine Resistant. Provide all product documentation and warranties.

2.7 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.1 COMPRESSIBLE FOAM SEALANTS

A. A. Material: Pre-compressed, impregnated open-cell polyurethane or acrylic foam sealant, factory pre-coated with an adhesive or mastic facing and packaged in a pre-compressed state for field expansion after installation.

B. Performance Requirements:

1. Movement Capability: Minimum ±25 percent of nominal joint width.
2. Air Infiltration: ≤ 0.01 cfm/ft² at 1.57 psf (per ASTM E283).
3. Water Penetration: No leakage at 6.24 psf (per ASTM E331).
4. Temperature Range: Serviceable from -40°F to +185°F (-40°C to +85°C).
5. UV and Ozone Resistance: No deterioration per ASTM G155.

C. Compatibility: Confirm compatibility with adjacent sealants, coatings, and substrates.

D. Basis-of-Design Product:

1. EMSEAL – Emseal Emseal IB or AST Sealant (Watertight Impregnated Foam Seal).
2. Sika – Sika Emprise or Emseal WFR2.
3. BASF – MasterSeal NP 1 Pre-Compressed Foam Seal (or equal).

E. Color: As selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Cast Stone
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
    a. Perform 5 tests for the first 500 feet of joint length for each kind of sealant and joint substrate.

b. Perform one test for each 500 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Control and expansion joints in unit masonry.

b. Joints in dimension stone cladding.
c. Joints between metal panels.
d. Joints between different materials listed above.
e. Perimeter joints between materials listed above and frames of doors windows and louvers.
f. .
g. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT .
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:
   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doorsandwindows .
   c. .
   d. Other joints as indicated on Drawings.
2. Joint Sealant: Acrylic latex .
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. .
   d. Other joints as indicated on Drawings.
2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT .
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

END OF SECTION 079200

SECTION 07 95 13 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion joint cover assemblies for floor, wall, and ceiling surfaces.

1.2 RELATED REQUIREMENTS

A. Section 07 71 00 - Roof Specialties: Roof expansion joints.

B. Section 07 90 05 - Joint Sealers: Expansion and control joint finishing utilizing a sealant and bond breaker.

C. Section 09 21 16 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.3 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2010.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.

E. ASTM E1399/E1399M - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems; 1997 (2013).

F. ASTM E1612/E1612M - Standard Specification for Preformed Architectural Compression Seals for Buildings and Parking Structures; 1994 (Change 1, 2013).

G. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. See Section 01 33 00 - Submittal Procedures, for submittal procedures.

C. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.

D. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.

E. Samples: Submit two samples 12 inch long, illustrating profile, dimension, color, and finish selected.

F. Test Reports.

G. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

1.5 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for expansion joint covers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Expansion Joint Cover Assemblies:
   1. Construction Specialties, Inc: www.c-sgroup.com. BASIS-OF-DESIGN (see drawings)
   2. Inpro: www.inprocorp.com.
   3. MM Systems Corp: www.mmsystemscorp.com.
   4. Watson Bowman Acme Corp.: www.wbacorp.com.
   5. Balco Inc.: www.balcousa.com.

B. Preformed Compressible Expansion Joint Seal:
   1. Emseal Joint Systems: www.emseal.com.
   2. Watson Bowman Acme Corp.: www.wbacorp.com.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Joint Cover Styles: As scheduled.
   4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
   5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
   7. Provide inside and outside corner joint cover for wall-to-wall junction to complement wall-to-wall joint cover.

B. Floor Joint Covers: Coordinate with indicated floor coverings.
   1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
   2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
   3. Joint Cover Styles: No Bump.
   4. Centering Bar: Provide to maintain position of center cover plate between side frames.
   5. Provide joint cover for floor-wall junction to complement floor-to-floor joint cover.

C. Recessed Cover Plate: Recessed to accept field-applied finish materials.
   1. Recess Depth: As required to accommodate adjacent flooring.

D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.

E. Covers In Gypsum Board Assemblies: Provide style with surface mounted snap-on receivers with sliding center plate.

F. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

2.3 PREFORMED COMPRESSIBLE EXPANSION JOINT SEAL

A. Flexible profile manufactured from open-cell polyether urethane foam with a factory applied elastomeric silicone membrane coating designed to provide protection against moisture and water intrusion on vertical surfaces.
   1. Profile capable of providing a minimum of plus or minus 25 percent building movement and accommodate moderate variations in width of opening, complex directional change transitions and resist ultraviolet degradation.
   2. Coated on one side with pressure-sensitive adhesive and covered with protective wrapping
   3. Profile installed without use of field applied adhesives or invasive anchor systems.
   4. 100 percent free of wax or asphalt compounds.

2.4 PERFORMANCE REQUIREMENTS

A. Materials and systems tested to provide fire rating equal to that of the adjacent construction.
   1. Tested under positive pressure according to ASTM E119 or ASTM E814.

B. Floor covers shall resist a maximum point load of 2000 pounds without damage or permanent deflection.

C. Movement capacity of joint covers in compliance with test results of ASTM E1399/E1399M.

2.5 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
   1. Exposed Finish at Floors: Mill finish or natural anodized.
   2. Exposed Finish at Walls: Natural anodized.
   3. Exposed Finish at Ceilings: Painted white finish.

B. Resilient Seals:
   1. For Ceilings: Neoprene or Santoprene resilient material, flush, pleated, or hollow gasket; Shore A hardness of 40 to 75 Durometer.
   2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.

C. Silicone Facing: Custom color as selected.

D. Anchors and Fasteners: As recommended by cover manufacturer.

E. Compression Seals: ASTM E1612/E1612M preformed elastomeric extrusions.

F. Resilient Filler Exposed to View: Gray.

G. Threaded Fasteners: Stainless steel.

H. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

I. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period.

J. Moisture Barrier: 7-ply laminate reinforced polyethylene.

2.6 ACCESSORIES

A. Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

B. Furnish frame depth for floor joints to accommodate floor finish thickness.

3.2 PREPARATION

A. Provide anchoring devices for installation and embedding under Section 03 30 00.
   1. Provide templates and rough-in measurements.

3.3 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
   1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

C. Align work plumb and level, flush with adjacent surfaces.

D. Rigidly anchor to substrate to prevent misalignment.

E. Precompressed Expansion Joint Seal: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

B. Provide strippable coating to protect finish surface.

3.5 SCHEDULE

		Model #	Comments
1ST FLOOR	**2" Expansion Joint**		
	Floor	NONE	
	Wall	FWF 200M FB	FIRE BARRIER
		FWF 200	
	Ceiling	PCW 200	
		ASM 200	
		FCF 200	
		ASMCX	
		FCFC 200	
	Exterior	VRF+SF 400	
		VF 300	

2ND FLOOR	**3" Expansion Joint**

	Floor	SSR 300	
		PCS 2G 300	
	Wall	FWF 300	FIRE BARRIER
		PCW 300	FLOOR TO WALL
		PCW 2G 300 FB	FIRE BARRIER
	Ceiling	ASM 300	
		FCF 300	
		ASMCX 300	
	Exterior	VRF+SF 400	
		ASM 300 FB	FIRE BARRIER
		PCW 2G 300	

3RD FLR		**3" Expansion Joint**	
	Floor	PCS 300	
	Wall	FWF 300	
	Ceiling	ASMCX 300	
		ASMC 300	
	Exterior	VRF+SF 400	
		VFR 400	
		BRJW-EJ R 400	

4TH FLR		**4" Expansion Joint**	
	Floor	PCW 2G 400 R	
	Wall		
	Ceiling		
	Exterior	VRF+SF 400	
		BRJ WC R 400	

ROOF		**4" Expansion Joint**	
	Exterior	VRF+SF 400	
		BRJ WC R 400	

3.6 SCHEDULE (EXTERIOR)

A. Wall to Wall Joint, Recess Mounted: Preformed compressible expansion joint seal.
   1. Basis of Design: Emseal, Colorseal
   2. Type: Compression Seal.
   3. Face color: Silicone facing in selected color to match adjacent wall color.
   4. Size as required to provide weathertight seal when installed.

END OF SECTION

DIVISION

08

OPENINGS

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 04 Section 04 20 00 "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
3. Division 08 Section 08 71 00 "Door Hardware".
4. Division 09 Sections 09 91 23 "Interior Painting", 09 97 13 Steel Coatings for field painting hollow metal doors and frames.
5. Division 28 Section "Access Control Hardware".

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.

13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors and 1/8” or less gap.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.

1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM C1363 and meet or exceed the following requirements:

a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.37, R-Value 2.7, including insulated door, thermal-break frame and threshold.

2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:

a. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section 01 31 19 "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Pioneer Industries (PI).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by

referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.
2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 “Laminated Core”.

    a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on- center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
    b. Thermal properties to rate at a fully operable minimum U-Factor 0.37 and R-Value 2.7, including insulated door, thermal-break frame and threshold.
    c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.

3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

2. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. CECO Door Products (C) Honeycomb Core - Regent Series.
2. CECO Door Products (C) Energy Efficient - Trio-E Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
3. Manufacturers Basis of Design:

    a. CECO Door Products (C) – SU SR Series.
    b. CECO Door Products (C) – Thermal Break TQB Series.

D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:

    a. CECO Door Products (C) - SU Series.

E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LOUVERS

A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.7 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.

3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware"08 71 00.
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware" 08 71 00.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections 01 77 00 “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 08 11 13

SECTION 08 14 23 - IMPACT RESISTANT DOORS (FLUSH)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Related Sections:
   1. Section 08 11 13: Hollow Metal Doors and Frames
   2. Section 08 71 00: Door Hardware

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction**,** louvers, and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
   1. Indicate dimensions and locations of mortises and holes for hardware.
   2. Indicate dimensions and locations of cutouts.
   3. Indicate requirements for veneer matching.
   4. Indicate doors to be factory finished and finish requirements.
   5. Indicate fire-protection ratings for fire-rated doors.

C. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain doors with from single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

D. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful inservice performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Mark each door on edge of top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
   3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Construction Specialties, Inc. Acrovyn Door Systems (800) 972-7214
   2. Or approved equal

2.2 DOOR CONSTRUCTION, GENERAL

A. 20-minute interior flush wood doors conforming to WDMA I.S.1A-04 and the following:
   1. Thickness: 1-3/4” (+/- 1/16”)
   2. Grade: Premium
   3. Construction: 7 ply
   4. Core: Agrifiber Particleboard Grade LD-1, 26-28 lb/ft3 (11.79 – 12.70kg/m³) density – rapidly renewable and no added urea formaldehyde content, CARB Phase I compliant
   5. Crossbanding: FSC certified .125” tempered hardboard
   6. Replaceable Door Stiles: ¾” replaceable stiles shall be field replaceable if ever damaged by impact
   7. Replaceable Edges: Fully wrapped and rounded Acrovyn door edge shall be replaceable, exclusive of fasteners to improve appearance.
   8. WDMA I.S.1A-04 Performances Duty Level: Extra Heavy Duty
   9. Durability Performance: Cycle Slam WDMA TM-7, 1990 Extra Heavy Duty – 2,000,000 cycles to insure durability of entire door construction.

B. Door Faces
   1. Door faces to be high impact resistant Acrovyn finish: (TGMC Maple)
   2. Acrovyn base color must be integral throughout to eliminate discoloration caused by scratching.
   3. Wood grain pattern to give appearance of one entire wood veneer to avoid inconsistencies in appearance – book matching or slip matching appearance not acceptable.
   4. Face Veneer Wear Index – Abrasion Resistance Testing – ASTM D4060-90: 28,000 cycles to prove out resistant to scuffing and scratching.
   5. Face Veneer Impact Resistance – ASTM D-4226: 86 in/lb. to confirm impact resistance of face finish.

C. Door stiles to meet or exceed the following performance testing to ensure hardware fastener holding strength:
   1. WDMA TM-8 “Hinge Loading resistance” Extra Heavy Duty
   2. WDMA TM-10 “Screw Holding Capacity: Extra Heavy Duty

D. Door Edges:
   1. Finish
      a. Edges of door to be PVC-free impact resistant Acrovyn: “TGMC Maple”
   2. Edges are covered by our “Edge of a Lifetime” Lifetime Limited Warranty from Construction Specialties Acrovyn Door Systems against damage, and begins 1 month after installation. Refer to warranty for full details.
   3. Edges are to fully wrap the door vertical stiles to eliminate banded edges thus improving durability and impact resistance.
   4. Replaceable edges to be ¾” (19.05MM) thick for proper edge and face protection.
   5. Door edges shall be exclusive of fasteners to improve appearance.
   6. Edges must be flush with face of door thus eliminating raised edges that could be torn off.
   7. Edges to include ¼” (6.35mm) radius edges to improve impact deflection. Square or banded edges should not be permitted.
   8. Edges are to be extruded (not formed) to ensure correct appearance and proper door fit.

E. Adhesives
   1. Crossbanding to core adhesives shall be urea formaldehyde free Type II to improve structural integrity of door.
   2. Door faces are to be applied to the crossbanded core using Type I urea formaldehyde free adhesives to eliminate delamination.

F. Cores
   1. 20-minute doors
      a. FSC Certified Particleboard grade LD-2, 32 lb/ft3 density – no added urea formaldehyde content, CARB Phase I compliant

2.3 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
   1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
   1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Cut and trim openings through doors in factory.
   1. Light Openings: Trim openings with moldings of material and profile indicated.

D. Blocking: provide blocking approved for use in doors of fire ratings indicated as needed to eliminate through-bolting for surface applied hardware.

2.4 FACTORY FINISHING

A. Finish doors at factory.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
      a. Comply with NFPA 80 for fire-rated doors.
   2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
   3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Access doors and frames for walls and ceilings.
   2. Floor access doors and frames.
   3. For chlorine resistance access panels suitable for use in pool area where corrosion and humidity are significant concerns.

B. Related Sections include the following:
   1. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 SUBMITTALS

A. Product Data: For each type of product
   1. Include construction details, fire ratings, if applicable, materials, individual components and profiles and finishes.

B. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching provisions, functions and installation procedures

C. Shop Drawings, indicate panel locations, sizes and special conditions.

D. Samples: Submit finish samples as requested

E. Warranty: Manufacturer's standard warranty.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. A. Fire-Rated Access Doors and Frames for Rated Walls and Ceilings:
   1. Units shall comply with **NFPA 80** and shall be identical to access door and frame assemblies tested for fire-test-response characteristics according to the following methods:
      a. **NFPA 252** or **UL 10B** for vertically installed fire-rated access doors.
      b. **NFPA 288** for horizontally installed fire-rated access doors.
   2. Units shall be **listed and labeled** by **UL** or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Corrosion Resistance for Chlorinated Environments (Natatoriums):
   1. Access doors and frames exposed to pool environments shall be fabricated from **Type 316 stainless steel** or materials demonstrating equivalent corrosion resistance.
   2. Finish and assembly shall resist **chlorinated water, chloramines, high humidity, and cleaning chemicals** typical of indoor pool environments.
   3. **Fasteners, hinges, and latches** shall be corrosion-resistant and compatible with the primary metal to prevent galvanic corrosion.
   4. Manufacturer's recommended **protective finishes, passivation, and sealing methods** shall be applied to all surfaces exposed to the pool atmosphere.
   5. Units shall comply with applicable **ASTM and NFPA standards for corrosion resistance** in chlorine environments.
   6. **Chlorine Resistance Testing:**
      a. Materials and finishes shall withstand **ASTM G85 (Prohesion test modified for chlorinated atmospheres)**.
      b. Materials and finishes shall resist **continuous immersion or cyclic exposure to chlorinated water** per **ASTM G31**.
      c. Surfaces shall show **no pitting, blistering, or corrosion staining** after accelerated exposure simulating

C. General Performance Requirements:
   1. Units shall function properly under **normal operational conditions**, including repeated opening and closing without binding, warping, or deterioration of finishes.
   2. Doors shall provide **tight-fitting closure**, alignment, and smooth operation as intended by the manufacturer.
   3. Assembly components shall be **compatible and durable**, preventing premature failure due to mechanical stress or environmental exposure.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acudor Products, Inc.
   2. Access Panel Solutions
   3. Alfab, Inc
   4. Babcock-Davis
   5. Cendrex Inc.
   6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
   7. Jensen Industries.
   8. J. L. Industries, Inc.
   9. Karp Associates, Inc.
   10. Larsen's Manufacturing Company.
   11. MIFAB, Inc.
   12. Milcor Inc.
   13. Nystrom, Inc.
   14. Williams Bros. Corporation of America (The).
   15. Or approved equal

C. Flush Access Doors and Frames with Exposed Flanges:
   1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturere's standard-width exposed flange, proportional to door size
   2. Locations: Wall and ceiling
   3. Door size: To accommodate easy access to devices without over-sizing

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Flush Access Doors and Frames: Fabricated from steel and stainless-steel sheet.
   1. Locations: Stainless steel at ceramic-tile, pools and other wet areas; steel at gypsum board and similar wall and ceiling surfaces in back of house areas.
   2. Door: Minimum 0.060-inch- thick sheet metal, set flush with surrounding finish surfaces or with exposed face flange of frame.
   3. Frame: Minimum 0.060-inch- thick sheet metal with exposed flanges.
   4. Hinges: Manufacturer’s standard.
   5. Latch: Screwdriver-operated cam latch.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel and Metallic-Coated-Steel Finishes:
   1. Factory prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

E. Stainless-Steel Finishes:
   1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
   2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.Run grain of directional finishes with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
   3. Directional Satin Finish: No. 4.
   4. Concealed hinge and flush screwdriver latch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.3 INSTALLATION

A. Provide access doors and frames for all equipment which may require constant or periodic operation or adjustment such as but not limited to valves, cleanouts, automatic smoke and fire dampers, damper operators, variable volume equipment, located in or above inaccessible ceilings, walls, or chases.

B. Provide fire-rated access doors and frames at rated walls, partitions and ceilings.

C. Comply with manufacturer's written instructions for installing access doors and frames.

D. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

E. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.4 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service doors.
2. Counter doors.
3. Fire-rated counter doors.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.
2. Division 09 Sections "Exterior Painting" and "Interior Painting" for finish painting of factory-primed doors.
3. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Wind Loads:

a. Basic Wind Speed: 135 mph.
b. Exposure Category: B.

2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

C. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 40 lbf/sq. ft. wind load, acting inward and outward.

D. Windborne-Debris-Impact-Resistance Performance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996.

1. Large Missile Test: For overhead coiling doors located within 30 feet of grade.
2. Small Missile Test: For overhead coiling doors located more than 30 feet above grade.

E. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.4 SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:

1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Show locations of replaceable fusible links.
3. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Curtain Slats: 12 inches long.
2. Hood: 6 inches square.

E. Qualification Data: For qualified Installer.

F. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10 inch wg for both ambient and elevated temperature tests.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Stainless-Steel Door Curtain Slats: ASTM A 666, Type 304; sheet thickness of 0.025 inch and as required to meet requirements.
2. Aluminum Door Curtain Slats: ASTM B 209 sheet or ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch and as required to meet requirements.
3. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch and as required to meet requirements.
4. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
5. Removable Posts and Jamb Guides for Counter Doors: Manufacturer's standard.
6. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
7. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
8. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.

B. Endlocks for Counter Doors: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Bottom Bar for Counter Doors: Manufacturer's standard continuous channel or tubular shape, fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.

D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

E. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

F. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.

G. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

H. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

1. Removable Posts and Jamb Guides for Counter Doors: Manufacturer's standard.

2.2 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Aluminum: 0.040-inch- thick aluminum sheet complying with ASTM B 209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
2. Stainless Steel: 0.025-inch- thick stainless-steel sheet, Type 304, complying with ASTM A 666.

2.3 COUNTER DOORS

A. Integral Frame, Hood, and Fascia for Counter Door: Welded sheet metal assembly of the following sheet metal:

1. Stainless Steel: 0.062-inch- thick stainless-steel sheet, Type 304, complying with ASTM A 666.

2.4 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware.".
2. Keys: Provide Three for each cylinder.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 CURTAIN ACCESSORIES

A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

1. Provide pull-down straps or pole hooks for doors more than 84 inches high.

2.6 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.7 MANUAL DOOR OPERATORS

A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.

B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf.

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 30 lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.8 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.

1. Electrical Characteristics:

   a. Phase: Polyphase.
   b. Volts: 208 V.
   c. Hertz: 60.

2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."

1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

L. Radio-Control System: Consisting of the following:

1. Three-channel universal coaxial receiver to open, close, and stop door; one per operator. Mount to wall near door.
2. Multifunction remote control.
3. Remote-antenna mounting kit.

2.9 DOOR ASSEMBLY – INTERIOR COUNTER

A. Counter Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Basis-of-Design: Subject to compliance with requirements, provide products by Cookson company, or comparable products by one of the following:

a. Cornell Iron Works, Inc.
b. Overhead Door Corporation.

B. Operation Cycles: Not less than 100,000.

1. Include tamperproof cycle counter.

C. STC Rating: 26.

D. Door Curtain Material: Stainless steel.

E. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height.

F. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Integral Frame, Hood, and Fascia for Counter Door: Stainless steel.

1. Mounting: Face of wall.

H. Sill Configuration for Counter Door: No sill.

I. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn.

J. Manual Door Operator: Manufacturer's standard crank operator.

1. Provide operator with through-wall shaft operation.
2. Provide operator with manufacturer's standard removable operating arm.

K. Door Finish:
1. Stainless-Steel Finish: No. 4 (polished directional satin).
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.10 EXTERIOR DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cookson Company; or comparable product by one of the following:

a. Cornell Iron Works, Inc.
b. Overhead Door Corporation.

B. Operation Cycles: Not less than 100,000.

1. Include tamperproof cycle counter.

C. Curtain R-Value: 6.0 deg F x h x sq. ft./Btu.

D. Door Curtain Material: Aluminum.

E. Door Curtain Slats: Flat profile slats of 3-1/4-inch center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Hood: Match curtain material and finish.

1. Shape: Square.
2. Mounting: Between jambs.

H. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside with thumb turn and outside with cylinder.

I. Electric Door Operator:

1. Usage Classification: Medium duty, up to 15 cycles per hour.
2. Operator Location: Top of hood.
3. Motor Exposure: Interior.
4. Emergency Manual Operation: Chain type.
5. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar ; self-monitoring type.

a. Sensor Edge Bulb Color: Black.

6. Remote-Control Station: Interior.
7. Other Equipment: Radio-control system.

J. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.11 FIRE-RATED COUNTER DOOR ASSEMBLY FOR CONCESSIONS

A. Fire-Rated Counter Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cookson Company; or comparable product by one of the following:

a. Cornell Iron Works, Inc.
b. Overhead Door Corporation.

B. Operation Cycles: Not less than 20,000.

1. Include tamperproof cycle counter.

C. Fire Rating: 3/4 hour with smoke control.

D. STC Rating: 27.

E. Door Curtain Material: Stainless steel.

F. Door Curtain Slats: Curved profile slats of 1-1/4-inch center-to-center height.

G. Integral Frame, Hood, and Fascia for Counter Door: Stainless steel.

1. Mounting: Between jambs.

H. Sill Configuration for Fire-Rated Counter Door: Integral metal sill.

I. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumbturn.

J. Manual Door Operator: Chain-hoist operator.

K. Door Finish:

1. Stainless-Steel Finish: No. 4 (polished directional satin).
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

2.14 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 083449 - RADIATION SHIELDING DOOR AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufactures that are not current members of the Steel Door Institute.

E. Informational Submittals:

1. Certificates of Compliance: Submit any information necessary to indicate compliance with this specification section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver radiation shielding work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store radiation shielding work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.5 COORDINATION

A. Coordinate installation of anchorages for radiation shielding frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.6 WARRANTY

A. Provide manufacturer's written 5 year warranty against defects in materials and workmanship upon final completion and acceptance of Work in this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CECO Door Products (C).
2. Curries Company (CU).
3. Security Metal Products (SMP).

B. Substitutions: Material from alternate radiation shielding door and frame fabricators will not be accepted on jobsite without prior written and sample approval in accordance with requirements specified in Division 01.

2.2 MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

B. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Lead Glazing: Comply with requirements in Division 08 Section, "Glazing."

2.3 RADIATION SHIELDING DOORS

A. General: Provide 1-3/4 inch doors of type and design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard vertical steel-stiffener core.

a. Standard Vertical Steel-Stiffener Core: Minimum 22 gage steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers.
b. Lead Core: Rolled pure sheet lead conforming to ASTM B749.

1) Provide cores with minimum thickness sheet lead as specified:

a) 1/16-inch.

c. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gage (0.053-inch - 1.3-mm) thick steel, Model 2 (Fully welded, seamless face and edges).
4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gage (0.053-inch - 1.3-mm), extending the full width of the door and welded to the face sheet. Finish top and bottom to provide a smooth flush condition.
6. Surface Applied Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.4 RADIATION SHIELDING FRAMES

A. General: Provide frames of the type and profile indicated, not less than thickness indicated; to comply with ANSI/SDI A250.8.

1. Fabricate frames with mitered corners.
2. Fabricate frames with "closed and tight" mitered, full depth continuously welded seams, finished smooth with no visible seam unless otherwise indicated. Knock down type frames are not permitted.
3. Minimum 16 gage (0.053-inch -1.3-mm) thick steel sheet
4. Lead-lining: Rolled pure sheet lead conforming to ASTM B749, matching sheet thickness specified for lead door cores.

B. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

C. Surface Applied Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup anchors to suit frame size, not less than 16 (0.8 mm) gage thickness, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud Wall Type: Designed to engage stud and not less than 16 gage (0.8 mm) thickness.

B. Floor Anchors: Floor anchors to be provided at each jamb. Formed from same material as frames, not less than 14 gage (0.067-inch -1.7-mm) thick.

C. Mortar Guards: Provide minimum 26 gage mortar guards welded to the back of each hardware cutout.

2.6 STOPS AND GLAZED LITES

A. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Factory installed, minimum 16 gauge (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

2.7 FABRICATION

A. Fabricate radiation shielding work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate radiation shielding work to tolerances indicated in ANSI/SDI A250.8.

C. Radiation Shielding Doors:

1. Glazed Lites: Factory cut openings in doors with applied flush trim kit to fit.
2. Astragals: Provide lead-lined overlapping astragals on one leaf of pairs of doors where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
3. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 08 Section, "Door Hardware".

D. Radiation Shielding Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Full depth continuously weld frame seams; grind, fill, dress, and make smooth and flush.

a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

3. High Frequency Hinge Reinforcement: Provide 12 gage angle reinforcements for butt type hinges on every door and frame assembly.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gage straps for continuous hinges
5. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; this includes but not limited to electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as noted in door hardware sets in Division 08 Section, "Door Hardware".

    a. Provide electrical knock out boxes as required for Project.
    b. Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
    c. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section, "Door Hardware".
    d. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.

6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
7. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry and Stud Wall Types: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 84 inches (2137 mm) high.

E. Surface Hardware Preparation: Factory prepare radiation shielding work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section, "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of radiation shielding work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

F. Stops and Moldings: Provide factory installed stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricators shop.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of radiation shielding work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so glazed lites are capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

2.8 STEEL FINISHES

A. Prime Finish: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded radiation shielding frames for squareness, alignment, twist, and plumbness.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install radiation shielding work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Radiation Shielding Frames: Install radiation shielding frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with appropriate mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Radiation Shielding Doors: Fit radiation shielding doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
c. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements and with door manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including radiation shielding work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from radiation shielding work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Section 01 77 00 “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 083449

SECTION 08 35 13.23 – WON-DOOR FIREGUARD ACCORDION-FOLDING FIRE DOORS (ACCESS CONTROL)

PART 1 – GENERAL

1.01 SUMMARY OF WORK

A. Division 0 and 1, as indexed, apply to this section.

B. Furnish and install all horizontal-sliding accordion-folding fire doors shown on the drawings and specified herein.

1.02 RELATED SECTIONS

A. All headers, support structures, fire protection of support structures, surrounding insulation, jambs, storage pockets, blocking and trim shall be furnished and installed by other sections.

B. All electrical wire, wiring, conduit and electrical boxes shall be furnished and installed by electrical section including connections to smoke detectors and building fire and access control alarm panels.

C. Drilling/placement of anchorage points into pre or post tensioned decks, welding/ punching/drilling steel members and all drywall work by other sections.

D. All track, soffit, chain guide and striker shall be painted by Section 09 90 00. Color shall be selected by the architect.

E. Interface to the doors is to be accomplished by use of a LOK Module and a remote line interface. A twisted pair of stranded 18-gauge copper conductors is to be provided between the LOK Module at the door location and the remote line interface (5,000' max. wire length). Wiring from the remote line interface (RLI) to the control device shall be stranded 18-gauge copper conductors (20' max. distance from control device).

1.03 QUALITY ASSURANCE

A. Installation shall be performed by factory trained and certified installers with experience installing electrically operated accordion folding fire doors.

B. Fire doors shall be listed by Underwriters Laboratories for ratings as indicated, when tested in accordance with the requirements of UL 10B and NFPA 252.

C. Automatic closing system shall be listed by Underwriters Laboratories in accordance with the requirements of UL 864 and UL 294, and in compliance with NFPA 80.

D. Fire doors used for smoke and draft control shall bear the "S" mark on the fire door UL label and shall have an air leakage of less than 3 CFM/ft^2 at 0.1 inch of water column pressure when tested in accordance with UL 1784 with an artificial bottom seal.

E. Fire Doors shall be capable of resisting an air pressure differential up to 0.05 inches of water column. Optional air pressure resistance up to 0.15 inches of water column available. (See 2.05 H)

1.04 SUBMITTALS

A. See Section 01 30 00 – Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's technical literature, include UL listing data.

C. Shop Drawings: Indicate construction and installation details and dimensions, including layout, electrical requirements, required stack depth, height of header above finished floor, and requirements for anchorage and support of each door.

D. Operation and Maintenance Data: Operating procedures, troubleshooting and repair methods, and wiring diagrams.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's agent will deliver original, unopened packages to a location designated by the General Contractor. All packages must be stored indoors, protected from moisture damage and secure from theft or other damage. General Contractor to note any damage or shortages at time of delivery.

1.06 COORDINATION BY GENERAL CONTRACTOR

A. Coordinate with the following:

1. Fire Alarm system.
2. Electrical.
3. Pocket cover doors (if required).
4. Floor and ceiling finish.

B. Assure accurate installation of header, jamb, and trim. Provide "As-Built" dimensions for opening and storage pocket. Supervise unloading and handling of materials.

C. Store boxes flat (not more than three high) in a protected dry area.

D. Permanent power shall be in-place and ready for final connection when fire and access control doors are installed. Assure access to and proper clearance for motor operators.

E. After testing the fire alarm system, automatic-closing fire doors shall be re-set to the original position.

1.07 WARRANTY

A. Materials and installation shall be warranted against defects in workmanship for a period of two (2) years from the date of substantial completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Horizontal-sliding, accordion-folding, fire doors as manufactured by Won-Door Corporation shall be specified as the following:

Won-Door FireGuard *CS 60 – S-FLP,* or approved equal.

2.02 ACCORDION FIRE DOORS – GENERAL

A. Provide electrically powered self-closing fire doors of configurations indicated on the drawings.

1. Fire rating as required.

B. **Fire Rating** – Fire doors shall be listed by Underwriters Laboratory as special purpose fire doors fire protection rating in accordance with the requirements of UL 10B and NFPA 252.

C. **Single Parting**: Door opening can be configured in a single parting (pocket at one end condition.

D. **Closing and Opening Operation**: Automatic Closing System, listed to UL864 including motor operator and releasing devices shall be a Microprocessor-based system and shall commence closing upon activation by fire signal, access control signal, low battery voltage or optional low AC voltage.

1. Obstruction Detection: Contact with an obstruction shall cause the door to stop, reverse enough to remove pressure on the leading edge, pause, and then re-close when in an alarm condition.
2. Constant pressure to the leading edge while not under motor power shall prevent motor operation and allow the door to be opened manually.

E. **Exit Device Operation**: Provide an exit device on one or both sides of door.

1. In emergency mode, a slight pressure on the exit device will cause the door to open a minimum of 32 inches, pause for 3 seconds, and then automatically close.
2. The open distance shall be field programmable, up to the entire opening width.
3. The pause before re-close shall be field programmable up to 30 seconds.
4. The exit device shall have the ability when not in the emergency (fire) mode to be used to open the door and move it back into the storage pocket.

2.03 ACCORDION FOLDING FIRE DOORS + ACCESS CONTROL – GENERAL

A. **FireGuard + Access control doors** restrict access and protect occupants against forced entry in designated areas of the building. They are equipped with the following features:

1. **Two parallel accordion type walls** independently suspended for advanced security protection (Single wall systems not permitted).
2. **Anti-Sway brackets** (resists 50 lbs. of lateral force with less than 6” of lateral movement with no floor track or other devices securing the door to the floor).
3. **Lock** (motor brake secures the door in position with up to 600 lbs. resistance).
4. **Heavy duty track support system** (counters excessive use and abuse conditions).
5. **Security jamb stops** (secures the jamb end of the door in the pocket).
6. **Reset device:** A reset device is required to clear the door from alarm and fault mode (See 2.05 G for reset device options).

B. **Door Operation**: Automatic Closing System, listed to UL864 and UL294 including motor operator and releasing devices shall be a Microprocessor-based system and shall commence closing upon activation by access control signal from security controller.

1. Obstruction Detection: Contact with an obstruction shall cause the door to stop, reverse enough to remove pressure on the leading edge, pause, and then re-close when in an alarm condition.

C. **Exit Device Operation**: Provide an exit device on one or both sides of door.

1. In security mode, a slight pressure on the exit device on the egress side of the door will cause the door to open to a designated pre-set distance, pause for 3 seconds, and then automatically close. The exit device on the ingress side (secured side) of the door may be excluded. If it is included, it will be disabled to prevent unauthorized access. An owner selected control device will allow credentialed individuals access through the secured side.
2. The open distance shall be field programmable, up to the entire opening width.
3. The pause before re-close shall be field programmable up to 30 seconds.
4. The exit device shall have the ability when not in security mode to be used to open the door and move it back into the storage pocket. When fire mode occurs, the exit device(s) will be fully activated.

2.04 COMPONENTS

A. Door Construction: Two parallel, accordion-type walls independently suspended with no floor tracks or pantographs.

1. Panels: 24-gauge steel, V-grooved; modular in design; capable of in-place repair.
2. Perimeter Seals**:** shall consist of continuous extruded sweeps attached to the top and bottom of the fire door to form a smoke and draft seal.
3. Hanging Weight: 5.5 pounds per sq. ft when extended across opening.
4. Finish: All steel panels shall have factory-applied protective coatings.
5. Color: Manufacturer's standard platinum.

B. Suspension System: Two tracks, on 8- or 10-inch centers, attached to overhead structural support.

1. Track: 14-gauge cold rolled steel or 1/8" Aluminum extrusion.
2. Panel Hangers: Panels shall be suspended by a steel hanger pin and ball bearing roller system.
3. Narrow Lead Post Hangers: 8-wheel ball bearing trolley.
4. Flat Lead Post Hangers: Double ball bearing rollers at each side with an 8-wheel ball bearing trolley.

C. Power source shall be: 120-volt AC input. System operation voltage shall be dual sourced from DC power supply and backup battery.

D. Automatic Closing System shall be listed to UL864 including capability to send and receive signals from the Fire Control Panel and shall consist of the following:

1. Microprocessor based Electronic Control box with the ability to:
    a. Monitor dual power sources continually for peak performance including:
        1) Detect a missing battery, bad battery, or low battery condition.
        2) Detect if the charging circuit is bad.
        3) Detect fuse failures.
        4) Detect high or low AC conditions.

b. Monitor the health of the drive train.

c. Monitor inputs including faults associated with door block, exit device, patron hardware, and key switches.

d. Run a “watch dog” monitoring circuit which will force a software restart in the event the software hangs, including tracking the number of resets that occur for diagnostic purposes.

e. Withstand aberrant voltages up to 120 volts AC on the fire alarm input circuit without damage including the ability to indicate that the alarm circuit has not been wired as a dry contact, “no voltage” circuit when errant voltages are applied to the circuit.

f. Communicate with other microprocessors on the system via an internal bus system.

g. Indicate faults or supervised information both locally and at a remote location.

2. Motor Operator Assembly including a DC gear-motor, drive sprocket, clutch, and position sensors. The motor shall drive the door by means of a chain. Standard motor drive speeds range from 6”-10” per second.

a. High speed motor operation up to 18” per second is available for conditions requiring high occupant load egress and limited access control.

b. Leading Edge shall be pressure sensitive such that contact with an obstruction shall cause the door to stop, pause for a minimum of 3 seconds, then re-close when in alarm mode.

3. Exit Device will be located on each side of the door. (Standard operation when access control is not included).

4. An optional key switch by others may be provided for operating the door opened and closed when not in fire mode. Location of the key switch to be provided by the architect.

E. The header shall be provided as an integrated part of the door assembly and shall Include track, threaded rods and mechanical attachment hardware.

2.05 OPTIONS

A. Vision Panel consisting of a frame and clear glass assembly listed by Underwriters Laboratory

B. Reset Devices (required to clear the door from fault and alarm mode.) Options include:

a. Key Switch by others (Requires a 2 position, spring activation to neutral, normally open switch).

b. Key switch by Won-Door.

c. Wireless Reset Device by Won-Door using energy harvesting technology (no batteries required) for same room installation consisting of a wall mounted device that accepts any key card to activate a wireless transmitter that can be mounted directly to the wall. Requires Wireless Access Module to operate.

C. Air Pressure Resistance. When an air pressure differential is present at the door location, the standard door shall be capable of resisting an air pressure differential of 0.05" of water column. For air pressure differentials of 0.05" to 0.1" w.c., anti-sway brackets shall be placed interior to the door approximately every five (5) feet or less and lead post outriggers shall be provided. For air pressure differentials of 0.1" to 0.15" w.c., a reinforced vertical bar shall be provided at the lead post and a self-leveling lead post assembly shall provide motorized tracking of the leading edge of the door to assure proper closure at the striker.

J. Infrared Obstruction Detector is an infrared light beam provided to monitor the opening path. If an object is placed in the path of the door for more than 3 minutes, the beam shall cause the door to sound an alarm indicating a path obstruction.

2.06 RELATED CONSTRUCTION

A. Track Support Construction: Provide supports attached to structure and mounting surface for track including drilling/placement of anchorage points into decks, welding/punching/drilling steel members, and all drywall work; comply with door manufacturer's instructions and recommendations.

B. Pocket Construction: Provide rated pocket as specified for storage of accordion door when open; comply with door manufacturer's instructions and recommendations.

C. Protection: Protect installed work from damage.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that adjacent construction is suitable for installation of door.

B. Verify that electrical utilities have been installed and are accessible.

C. Verify clear opening dimensions and that door opening is plumb.

D. Notify Architect of any unacceptable conditions or varying dimensions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, shop drawings and NFPA 80.

B. Install fire doors plumb and parallel with the finished floor.

C. Installation shall be performed by factory trained and certified installers with experience installing electrically operated accordion folding fire doors.

3.03 ADJUSTING

A. Adjust door installation to provide uniform clearances and smooth, quiet, non-binding operation.

B. Test that all operations are functional and meet the requirements of local codes.

3.04 CLEANING

A. Clean surfaces using manufacturer's recommended means and methods.

3.05 STORAGE OF WASTE AND RECYCLING

A. Store and recycle waste in accordance with Section 01 74 19 Construction Waste Management and Disposal.

SECTION 08 42 10 - ALL GLASS ENTRANCES

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes:
   1. Interior Slender Profile Door Rails for all-glass entrance doors.

B. Related work in other sections:
   1. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
   2. Section 08 80 00 - Glazing: Glass and Glazing accessories.

1.02 SUBMITTALS

A. Product Data: Submit Manufacturer's product data for all glass entrance systems including:
   1. Manufacturer's standard details and fabrication method.
   2. Data on finishing, hardware and accessories.
   3. Recommendations for maintenance and cleaning of exterior finish surfaces.
   4. Test data on fabricated door.

B. Shop drawings for each interior all glass entrance system are required, including:
   1. Layout and installation details.
   2. Elevations at 1/4-inch scale.
   3. Detail sections of fittings.
   4. Hardware mounting heights.
   5. Anchorage and reinforcement.
   6. Glazing details.

C. Samples for approval:
   1. Submit pairs of samples of each specified metal color and finish on 9-inch long sections of extrusions or formed shapes.
   2. Submit samples of glass approximately 6 inches square showing the edge conditions.

1.03 QUALITY ASSURANCE

A. Installer qualifications: Engage an experienced installer who has completed installations of all glass entrances similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in service performance.

B. Manufacturer's qualifications: Provide all glass entrances produced by a firm experienced in manufacturing entrance systems that are similar to those indicated for this project and that have a record of successful in service performance. All door rail systems must be tested.

C. Single source responsibility: Obtain all glass entrance systems from a single manufacturer, to ensure full compatibility and warranty of parts.

D. Design criteria: The drawings indicate the size, profile and dimensional requirements of the all glass entrance system required and are based on the specific types and models indicated. All glass entrances by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

E. Safety glass standard: Provide tempered glass components that comply with ANSI Z97.1 and testing requirements of CPSC 16 CFR 1201 Category II.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver all glass entrances and related components in the manufacturer's original protective packaging. Do not deliver entrance units until the work is ready for their installation.

1. Inspect components for damage upon delivery. Unless minor defects in metal components can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check opening by accurate field measurement before fabrication. Show recorder measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work and possible damage to the finished product.

1. Where necessary, proceed with fabrication without measurement and coordinate fabrication tolerances to insure proper fit.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S

A. Basis of design: Dry Glaze Slender Profile Door Rail System for heavy tempered glass manufactured by:

C.R. Laurence Co., Inc. (CRL)
Tel: (800) 421-6144 Fax: (800) 587-7501
Email: architectural@crlaurence.com
Web Site: www.crl-arch.com

Or approved equal

2.02 MATERIALS

A. Glass: Provide flat, fully tempered glass in thickness indicated for doors and sidelites. Comply with requirements of ASTM C 1048 for FT (fully tempered), Condition A (uncoated surfaces), Type 1 (transparent) Class 1 (clear) glass. Provide products of thickness indicated that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR Part 1201 for Category II materials.

1. Thickness: 1/2 inch (12 mm)

2. Edge treatment: Provide machine ground and polished edges for exposed glass edges of doors and sidelites and flat ground edges for butting glass edges.
3. Glass Manufacturers: Refer to Glazing Specification.

C. Fittings, General: Provide CRL Slender Profile Door Rails in required height as selected by the Architect. Comply with requirements indicated for kind and form of metal finish.

1. Aluminum: Provide fittings fabricated from aluminum extrusions of alloy and temper recommended by manufacturer for use intended and required for application of finish indicated, but not less than strength and durability properties specified in ASTM B 221 for 6063-T5.

D. Door Rail Systems: Provide slender profile door rail systems matching metal and finish of door fittings. Comply with GANA guidelines, and hardware manufacturer requirements for size restrictions. Door rails shall allow for jamb adjustment in or out with standard hardware. System shall include, but not limited to, end caps, and preparation (7150 Series Cam Lock, and Pivot hardware is separate).

1. Slender Profile: 2 inch top (51 mm), 4 inch bottom (102 mm)

E. Accessory Fittings: Provide manufacturer's standard accessory fittings of the type indicated. Comply with requirements indicated for kind and form of metal and finish of door fittings.

1. Slender Profile Door Rail Pivot Inserts:
   a. Cat. No. 1NT801 for flat tapered floor closer spindle or free-swing floor spindle
   b. Cat. No. 1NT803 overhead free-swing pivot
   c. Cat. No. 1NT804 for overhead closer with 9/16 inch (14 mm) square spindle

2. Overhead Door Stop: Provide overhead door stop systems.

F. Anchors and Fasteners: Manufacturer's standard concealed anchors and fastenings. Do not use exposed fasteners.

2.03 HARDWARE

A. General: Provide heavy-duty hardware units as indicated, scheduled or required for operation of each type of door, including the following items of sizes, numbers and type recommended by the manufacturer for the type of service required. Provide metal and finish for exposed parts to match the finish of the door rails.

B. C.R. Laurence Co., 8300 Series Shallow Depth Floor Mounted Closers are double acting and supplied with a shallow 1-9/16 inch (40 mm) cement box and Brushed S/S cover plate. Cover plates in other finishes are available. Comply with manufacturer's recommendations for closer size, depending upon door size, and anticipated frequency of use.
Include the following:
1. Non-hold-open closers must comply with ADA Handicap requirements.
2. Consult manufacturer for closer recommendations on doors over 264 lbs.

C. C.R. Laurence Co., 9100 Series Extended Spindle Overhead Concealed Door Closers are double acting and supplied with a 3/4 inch (19 mm) extended spindle for use with slender profile door rails. Comply with manufacturer's recommendations for closer size, depending upon door size, and anticipated frequency of use.
Include the following:

1. Non-hold-open closers must comply with ADA Handicap requirements.
2. Consult manufacturer for closer recommendations on doors over 200 lbs.

D. Push-Pull Set: Provide handles selected by the Architect and supplied by C.R. Laurence.

E. C.R. Laurence Co., CRL9040 Series Center-Hung Top Pivot is used at the top of the door when insert 1NT803 Top Pivot is used.

2.04 FABRICATION

A. General: Fabricate all glass entrance components to designs and sizes indicated. Size of door and profile requirements of fittings and hardware are indicated on the drawings.
1. Locate and provide holes and cutouts in glass to receive hardware before tempering glass. Do not permit cutting, drilling or other alterations to glass after tempering.
2. Fabricate work to accommodate required fittings, hardware, anchors, reinforcement, and accessory items.

B. Prefabrication: Complete fabrication, assembly, finishing, hardware application and other work to the greatest extent possible before shipment to the project site. Disassemble components only as necessary for shipment and installation.

C. Continuity: Maintain accurate relation of planes and angles with hairline fit of contracting members.

2.05 METAL FINISHES: (List one or more finishes)

A. US-32 Polished Stainless Steel Clad
US-32D Brushed Stainless Steel Clad
Other Custom Metal and Painted finishes available

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and supports with the installer, present for compliance with requirements indicated, installation tolerances and other conditions that affect the installation of interior slender profile ‘all-glass’ entrances. Correct unsatisfactory conditions before proceeding with the installation.

1. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install slender profile all glass entrance door and associated components in accordance with manufacturer’s printed instructions and recommendations.

1. Verify units level, plumb and true line.
2. Lubricate hardware and other moving parts.

3.03 ADJUSTING

A. Adjust doors and hardware to provide a tight fit at meeting points and at weather-stripping for smooth operation and weather tight closure.

B. Hardware: Adjust operating hardware to ensure proper operation. Set, seal, and grout floor closer cases. Coordinate cylinder installation.

3.04 CLEANING

A. Clean door and frame surfaces after installation, exercising care to avoid damage to the finish.

B. Clean glass surfaces after installation, complying with requirements contained in the “Glass and Glazing” section for cleaning and maintenance. Remove excess glazing sealant compounds, dirt or other substances.

3.05 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that the all glass entrances do not incur any damage or deterioration, other than normal wear and tear, at the time of acceptance.

END OF SECTION 08 42 10

SECTION 08 42 29.43 - SLIDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior, biparting, impact rated sliding automatic entrances.
   1. Entrances shall include automatic locking.

B. Interior, biparting, sliding automatic entrances.

C. Interior, single slide, sliding automatic entrances
   1. Access control locking shall be on entrances.

1.2 RELATED REQUIRMENTS

A. Section 01 60 00 – Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

B. Section 07 90 00 - Joint Protection: Caulking to the extent not specified in this section.

C. Section 08 40 00 - Entrances, Storefronts and Curtain Walls: Entrances furnished and installed separately.

D. Section 08 71 00 - Door Hardware: Hardware to the extent not specified in this Section.

E. Section 09 21 16 – Gypsum Board Assemblies: Materials and installation requirements for gypsum board assemblies.

F. Division 26 00 00 – Electrical: Electrical connections provided separately, including conduit, and wiring for power to, monitoring of, and control of sliding automatic entrances.

G. Division 28 00 00 - Electronic Safety and Security: Systems not specified in this section.

1.3 DEFINITIONS

A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.

B. Knowing act: Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.

C. Safety Device: Device that prevents a door from opening or closing, as appropriate.

1.4 REFERENCE STANDARDS

A. General: Standards listed by reference, including revisions by issuing authority, form part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. American Architectural Manufacturers Association (AAMA):
   1. AAMA 607.1 - Clear Anodic Finishes for Architectural Aluminum.
   2. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.

3. AAMA 701 Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals.

C. American Association of Automatic Door Manufacturers (AAADM).

D. American National Standards Institute (ANSI) / Builders' Hardware Manufacturers Association (BHMA):
1. ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
2. ANSI/BHMA A156.5: Standard for Auxiliary Locks and Associated Products
3. ANSI Z97.1: Standard for Safety Glazing Materials Used In Buildings - Safety Performance Specifications And Methods Of Test.

E. American Society for Testing and Materials (ASTM):
1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
3. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

F. American Welding Society (AWS):
1. AWS A5.10/A5.10M - Specification For Bare Aluminum And Aluminum-Alloy Welding Electrodes And Rods.

G. Consumer Product Safety Commission (CPSC):
1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials.

H. International Code Council (ICC):
1. IBC: International Building

I. International Organization for Standardization (ISO):
1. ISO 9001 - Quality Management Systems

J. National Association of Architectural Metal Manufacturers (NAAMM):
1. Metal Finishes Manual for Architectural and Metal Products.

K. National Fire Protection Association (NFPA):
1. NFPA 101 – Life Safety Code.
2. NFPA 70 – National Electric Code.

L. Underwriters Laboratories (UL):
1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.5 COORDINATION

A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrances to comply with indicated requirements.

B. Electrical System Roughing-in: Coordinate layout and installation of automatic entrance assemblies with connections to power supplies, remote activation devices, and security access control system. Refer to Division 28 00 00 - Electronic Safety and Security" for systems not provided under this section.

C. System Integration: Integrate sliding automatic entrances with other systems as required for complete working installation.

1. Provide electrical interface control capability for activation of sliding automatic entrances by security access system on doors with electric locking.

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Section 01 30 00 – Administrative Requirements, submittal procedures.

B. Action Submittals:
1. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.
2. Color Samples for selection of factory-applied color finishes.

C. Closeout Submittals:
1. Owner’s Manual.
2. Warranties.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain automatic entrance door assemblies through one source from a single manufacturer.

B. Qualifications:
1. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.
2. Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility compliant with ISO 9001.
   a. Manufacturer shall have in place a national service dispatch center providing 24 hours per day, 7 days per week, emergency call back service.

C. Certifications: Automatic sliding door systems shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:
1. ANSI/BHMA A156.10.
2. IBC
3. NFPA 101.
4. UL 325 listed.

1.8 FIELD CONDITIONS

A. Field Measurements: General Contractor shall verify openings to receive automatic entrance assemblies by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.

C. Other trades: General Contract shall advise of any inadequate conditions or equipment.

1.9 WARRANTY

A. Automatic Entrances shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.

B. During warranty period Owner shall engage factory-trained technician to perform service and affect repairs. safety inspection shall be performed after each adjustment or repair and

completed inspection form shall be submitted to Owner.

C. During warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCES

A. Manufacturer: Stanley Access Technologies (www.stanleyaccess.com) (or approved equal):
1. Dura-Storm™ 3000 Series impact rated sliding automatic entrances.
2. Dura-Glide™ 3000 Series sliding automatic entrances.
3. Dura-Glide™ 2000 Series sliding automatic entrances.
4. Contact: Stanley Access Technologies, Russell Elkins; Phone: 985-624-5278, Fax: 985-626-9515, Email: Russell.Elkins@allegion.com**.**

B. Substitutions: See Specification Section 01 25 00 for Substitution procedures.

C. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of automatic entrance door assemblies and are based on specific system indicated. Refer to Section 01 60 00 – Product Requirements: Product Options.

2.2 IMPACT RATED AUTOMATIC ENTRANCE ASSEMBLIES

A. General: Provide manufacturer's standard automatic entrance assemblies including doors, sidelights, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.

B. Impact Rated Sliding Automatic Entrances:
1. Configuration: Two sliding leaves and two full sidelights; bi-parting.
2. Traffic Pattern: Two-way.
3. Emergency Breakaway Capability: Sliding leaves and sidelights
4. Mounting: Between jambs.
5. Maximum Dimensions: Not to exceed dimensions specified in product approvals; see 1.7 Quality Assurance.
6. Entrances 1000 and 1305A.

2.3 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

A. General: Provide manufacturer's standard automatic entrance door assemblies including doors, sidelights, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for complete installation.
1. Bi-Parting Entrances:
   a. Configuration: Two sliding leaves and two full sidelights; bi-parting.
   b. Traffic Pattern: Two-way.
   c. Emergency Breakaway Capability: Sliding leaves only. Sliding leaves and sidelights.
   d. Mounting: Between jambs.
   e. Entrance 1001
2. Single Slide Entrances:
   a. Configuration: One sliding leaf and one full sidelight single slide.
   b. Traffic Pattern: Two-way.
   c. Emergency Breakaway Capability: Sliding leaf only.
   d. Mounting: Between jambs.
   e. Entrances 1201, 1610 1630 and 2100B

2.4 DESIGN / PERFORMANCE CRITERIA

A. General: Provide automatic entrance assemblies capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Operating Range: Minus 30 deg F (Minus 34 deg C) to 130 deg F (54 deg C).

C. Opening-Force Requirements for Egress Doors: Not more than 50 lbf (222 N) required to manually set door in motion if power fails, and not more than 15 lbf (67 N) required to open door to minimum required width.

D. Closing-Force Requirements: Not more than 30 lbf (133 N) required to prevent door from closing.

E. Air Infiltration: Impacted rated sliding automatic entrance shall be designed maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sf. (6.4 L/s-m^2) of fixed entrance system area when tested according to ASTM E 283 at minimum static-air-pressure difference of 6.24 lbf/sf (299 Pa).

F. Design Pressures: Impact rated sliding automatic entrance systems shall be designed to withstand up to 80 psf (3830 Pa), wind force in both the positive and negative direction, and be large and small missile impact rated.

G. Impact rated sliding automatic entrances specified with automatic locking shall be designed to function as follows:
   1. Entrances shall be normally closed and locked by automatic locking system with exterior motion activation system disabled. Interior motion activation system to remain enabled; free egress.
   2. Upon signal from exterior secure activation device, sliding automatic entrances will unlock and open enabling motion activation system. Entrance will be held open as long as an object or pedestrian remains in the activation or safety zones.
   3. Once all activation and safety zones have cleared the entrance will close and re-lock, returning to normal state.
   4. At any time during the cycle emergency egress can be achieved by utilizing the emergency breakaway feature.

H. Sliding automatic entrances specified with access control locking shall be designed to function as follows when set for secure operation:
   1. Entrances shall be normally closed and locked by access control locking system with exterior motion activation system disabled. Interior motion activation system to remain enabled, free egress.
   2. Upon signal from exterior secure activation device, sliding automatic entrances will unlock and open enabling motion activation system. Entrance will be held open as long as object or pedestrian remains in activation or safety zones.
   3. Once all activation and safety zones have cleared the entrance will close and re-lock, returning to normal state.
   4. At any time during cycle emergency egress can be achieved by utilizing emergency breakaway feature.

2.5 REGULATORY REQUIRMENTS

A. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as required means of egress.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2.6 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Headers, stiles, rails, and frames 6063-T6
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   3. Sheet and Plate: ASTM B 209.

B. Steel Bars and Shapes – Impacted Rated Automatic entrances: Manufacturer's standard steel bars and shapes for reinforcing as required to support imposed loads.

C. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

D. Sealants and Joint Fillers: Performed under Section 07 90 00 - Joint Protection.

2.7 COMPONENTS

A. Framing Members: Manufacturer's standard extruded aluminum reinforced as required to support imposed loads.
   1. Nominal Size: 1 3/4 inch by 4 1/2 inch (45 by 115 mm).
   2. Concealed Fastening: Framing shall incorporate a concealed fastening pocket, and continuous flush insert cover, extending full length of each framing member.

B. Stile and Rail Doors and Sidelights for Impact Rated Sliding Entrances: Manufacturer's standard 1 ¾ inch (45 mm) thick glazed doors with extruded-aluminum tubular stile and rail members. Incorporate concealed tie-rods that span full length of top and bottom rails. All corners, including intersections of stiles and rails, or stiles and muntin bars, shall be welded secure.
   1. Glazing Stops and Gaskets: Snap-on, extruded-security aluminum inboard stops with preformed glazing gaskets. Mechanically fastened outboard gutter stop with approved structural glazing tape.
   2. Stile Design: Narrow stile; 2 inches (51 mm) nominal width.
   3. Bottom Rail Design: Minimum 4 inches (102 mm)] nominal height.
   4. Muntin Bars: Horizontal tubular rail member for each door; 2 inches (51 mm) nominal width.
   5. Steel Reinforcing: Manufacturer’s standard steel bars and shapes securely mounted within entrance components as required under product certifications.

C. Stile and Rail Doors and Sidelights for Automatic Sliding Entrances: Manufacturer's standard 1 ¾ inches (45 mm) thick glazed doors with extruded-aluminum tubular stile and rail members. Incorporate concealed tie-rods that span full length of top and bottom rails**.**
   1. Glazing Stops and Gaskets: Snap-on, extruded-security aluminum stops and preformed gaskets.
   2. Stile Design: Narrow stile; 2 inches (51 mm) nominal width.
   3. Bottom Rail Design: Minimum 4 inches (102 mm) nominal height.
   4. Muntin Bars: Horizontal tubular rail member for each door; 4 1/4 inches (108 mm) nominal height.

D. Glazing – Impacted Automatic Sliding Entrances: Glaze impact rated sliding automatic entrances in accordance with product approvals and the following:
   1. Provide safety glass complying with ANSI Z97.1 and CPSC 16 CFR 1201 for Category II materials.
   2. Glass: 1 1/8 inches (29 mm) insulated glazing units, with fully tempered panes in all panels. Insulated glass panes shall incorporate a 1/2 inch (13 mm) dehydrated air space.

a. Inboard lites shall be 3/16 inch (5 mm) clear tempered.
b. Outboard lites shall be 7/16 inch (11 mm) laminated impact rated glass as specified in product approvals.
c. Units shall be hermetically sealed with a dual seal.

3. Glazing: Outboard stop with approved structural tape.

E. Glazing – Automatic Sliding Entrances: Provide glazing for sliding automatic entrances as follows:
1. Provide safety glass complying with:
a. ANSI Z97.1
b. CPSC 16 CFR 1201 for Category II materials.
2. 1/4 inch (6 mm) clear, fully tempered, in all panels.

F. Headers: Fabricated from extruded aluminum and extending full width of automatic entrance door units to conceal door operators, carrier assemblies, and roller tracks. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
1. Mounting: Concealed, with one side of header flush with framing.
2. Capacity: Capable of supporting up to 220 lb (100 kg) per panel, up to four panels, over spans up to 14 feet (4.3 m) without intermediate supports.

G. Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment of at least 1/8 inch (3 mm); consisting of urethane with precision steel lubricated ball-bearing wheels, operating on a continuous roller track. Support panels from carrier assembly by load wheels and anti-riser wheels with factory adjusted cantilever and pivot assembly. Minimum two ball-bearing load wheels and two anti-rise rollers for each active leaf. Minimum load wheel diameter shall be 2 1/2 inches (64 mm); minimum anti-rise roller diameter shall be 2 inches (51 mm).

H. Thresholds: Manufacturer's standard saddle type thresholds as indicated below:
1. Entrances 1000, 101 and 1305A: Continuous standard tapered extrusion double bevel.
2. Entrances 1201 1610, 1630 and 2100B: None
3. All thresholds to conform to details and requirements for code compliance.

I. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.

J. Signage: Provide signage in accordance with ANSI/BHMA A156.10.

2.8 DOOR OPERATORS

A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, operation under normal traffic load for type of occupancy indicated.

B. Electromechanical Operators: Self-contained overhead unit powered by a minimum of 1/4 horsepower, permanent-magnet DC motor with gear reduction drive, microprocessor controller; and encoder.
1. Operation: Power opening and power closing.
2. Features:
a. Adjustable opening and closing speeds.
b. Adjustable open check and close check speeds.
c. Adjustable hold-open time between 0 and 30 seconds.
d. Obstruction recycle.
e. On/Off switch to control electric power to operator.
f. Energy conservation switch that reduces door-opening width.

g. Closed loop speed control with active braking and acceleration.
h. Adjustable obstruction recycle time delay.
i. Self-adjusting stop position.
j. Self-adjusting closing compression force.
k. Onboard sensor power supply.
l. Onboard sensor monitoring.
m. Optional Switch to open/Switch to close operation.
n. Fire alarm interface, configurable to safely open or close the entrance on signal from fire alarm system.

3. Mounting: Concealed.
4. Drive System: Synchronous belt type.

C. Electrical service to door operators shall be provided under Division 26 00 00 - Electrical. Minimum service to be 120 VAC, 5 amps.

2.9 ELECTRICAL CONTROLS

A. Electrical Control System: Electrical control system shall include a microprocessor controller and high-resolution position encoder. Encoder shall monitor revolutions of operator shaft and send signals to microprocessor controller to define door position and speed.
1. High-resolution encoder shall have resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
2. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.
3. A single controller shall be capable of controlling up to 2 operators per entrance system.

B. Performance Data: Microprocessor shall collect, and store performance data as follows:
1. Counter: Non-resettable counter to track operating cycles.
2. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
3. LED Display: Display presenting the current operating state of the controller.

C. Controller Protection: Microprocessor controller shall incorporate following features to ensure trouble free operation:
1. Automatic Reset Upon Power Up.
2. Main Fuse Protection.
3. Electronic Surge Protection.
4. Internal Power Supply Protection.
5. Resetable sensor supply fuse protection.
6. Motor Protection, over-current protection.

D. Soft Start/Stop: “Soft-start” “soft-stop” motor driving circuit shall be provided for smooth normal opening and recycling.

E. Obstruction Recycle: Provide system to recycle sliding panels when obstruction is encountered during closing cycle. If obstruction is detected, system shall search for that object on next closing cycle by reducing door closing speed prior to previously encountered obstruction location and will continue to close in check speed until doors are fully closed, at which time doors will reset to normal speed. If obstruction is encountered again, door will come to full stop. Doors shall remain stopped until obstruction is removed and operate signal is given, resetting door to normal operation.

F. Programmable Controller: Microprocessor controller shall be field programmable.
1. Following parameters may be adjusted:
a. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
b. Adjustable and variable features specified.

c. Reduced opening position.
d. Fail-secure control.

2. Manual programming shall be available through local interface which has two-digit display with selection control including three push buttons.

2.10 ACTIVATION AND SAFETY DEVICES

A. Primary Activation: Secure activation device provided by others as specified in Division 28 00 00 - Electronic Safety and Security.

B. Combined Activation and Safety Sensors: Combined activation and safety sensors shall, in single housing, detect motion and presence in accordance with ANSI/BHMA A156.10. Motion shall be detected using K-band microwave technology, presence by active infrared reflection technology.
1. Mounting Height: Up to 11.5 feet (3.5 m) above finish floor
2. Temperature Range: Between -31°F and 131°F (-35°C to 55°C) in all environmental conditions
3. Relays: Form C, 50V at 0.3A for both activation and safety. Hold time of less than 0.5 seconds.
4. Detection Pattern: When detection is made in the activation zone, and entrance opens, safety zone shall extend through threshold on each side; creating an X-pattern. When activation and safety zones are cleared, and entrance closes sensor will ignore X-pattern safety zones.
5. Motion activation is secondary to knowing act activation where scheduled.
6. Combined motion and presence sensors shall be equal to or better than X-Zone Sensor by Optex.

C. Photoelectric Beams: In addition to threshold sensor include minimum of two (2) doorway holding beams. Photoelectric beams shall be pulsed infrared type, including sender receiver assemblies for recessed mounting. Beams shall be monitored by electrical controls for faults and shall fail safe.

D. Presence Sensor Monitoring: Sliding automatic entrances control system shall include means to verify functionality of all active presence sensors in accordance with ANSI/BHMA A156.10. A detected fault shall cause automatic operation to cease until fault is corrected.

2.11 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated.

B. Emergency Breakaway Feature: Provide release hardware that allows panel(s) to swing out in direction of egress to full 90 degrees from any position in sliding mode. Maximum force to open panel shall be 50 lbf (222 N) according to ANSI/BHMA A156.10. Interrupt powered operation of panel operator while in breakaway mode.
1. Emergency breakaway feature shall include at least two adjustable detent devices mounted in each breakaway panel: one top mounted and one bottom mounted, to control panel breakaway force.
2. Wind Resistant Damper: Impact rate entrance provide factory installed concealed gas dampers in each breakaway panel to protect door panels from wind damage. Dampers shall be designed to slow panel movement after breakout.
3. Limit Arms: Automatic sliding entrances provide limit arms to control swing of sliding or non-sliding panels on break-out; swing shall not exceed 90 degrees. Limit arms shall be spring loaded to prevent shock and include adjustable friction damping.

C. Deadlocks: None.

1. Provide no deadlocks on Entrances 1001, 1201, 1610, 1630 and 2100B.

D. Panic Release Locking: Manufacturer's approved multi-point locking system with panic release hardware as follows:
   1. Four-Point Locking: Provide locking components within sliding panels, including panic release hardware, that extend flush bolts into overhead carrier assemblies and threshold of both sliding leaves. Flush bolts shall be manually dogged, or disengaged, for normal operation. Lock cylinders shall be provided to allow for disengagement of flush bolts from the exterior.
   2. Cylinders: As specified in Section 08 71 00 - Door Hardware.
   3. Panic release hardware shall be similar to or better than, Adams Rite G86-11-36.
   4. Provide panic release locking system on Entrances 1000 and 1305A.

E. Automatic Locking System: Provide automatic locking hardware on sliding automatic entrances as follows:
   1. System shall include a fail-secure electric solenoid locking device with a self-contained solid-state electronic control factory mounted inside the header.
   2. When set for secure operation, the automatic sliding entrance(s) shall electrically latch in the closed position preventing door panels from sliding manually, returning the system to its locked status.
   3. During a power interruption:
      a. The solenoid lock shall be engaged, preventing the doors from sliding manually.
      b. Means of egress shall be accomplished by standard emergency breakaway feature.
   4. Provide access control locking system on Entrances 1000 and 1305A.

F. Control Switch: Provide manufacturer’s standard header mounted rocker switches to allow for full control of the automatic entrance door. Rotary switches shall be keyed on entrances with automatic locking. Controls to include, but are not limited to:
   1. Open.
   2. Closed/Locked.
   3. Automatic
   4. One way.
   5. Reduced.
   6. Reduced one way.

G. Power Switch: Sliding automatic entrances shall be equipped with two positions On/Off rocker switch to control power to the door.

H. Sliding Weather Stripping: Manufacturer's standard replaceable components complying with AAMA 701.
   1. Impact Rated Entrance: Made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
      a. Provide double pile weather stripping on lead stiles of sliding panels.
      b. Provide single pile weather stripping between carrier and header, lead stiles of sidelights, and on pivot stiles of sliding panels.
   2. Automatic Sliding Entrance: Manufacturer's standard replaceable components complying with AAMA 701; made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

I. Weather Sweeps: Adjustable, dual brush, nylon brush sweep mounted to underside of door bottom.

2.12 FABRICATION

A. General: Factory fabricates automatic entrance assembly components to designs, sizes, and thickness indicated and to comply with indicated standards.
   1. Form aluminum shapes before finishing.
   2. Use concealed fasteners to greatest extent possible.
      a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
      b. Reinforce members as required to receive fastener threads.

B. Framing: Provide automatic entrances as prefabricated assemblies.
   1. Fabricate tubular and channel frame assemblies with manufacturer's standard mechanical or welded joints. Provide sub-frames and reinforcement as required for complete system to support required loads.
   2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
   3. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
   4. Form profiles that are sharp, straight, and free of defects or deformations.
   5. Prepare components to receive concealed fasteners and anchor and connection devices.
   6. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated.

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site.

2.13 ALUMINUM FINISHES

A. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
   1. AAMA 607.1
   2. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Do not install damaged components. Fit frame joints to produce joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
   1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
   2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

A. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 00 00 – Electrical.

B. Glaze sliding automatic entrance door panels in accordance with, the Glass Association of North America (GANA) Glazing Manual, published recommendations of glass product manufacturer, and sliding automatic entrance manufacturer's instructions.

C. Sealants: Comply with requirements specified in Section 07 90 00 - Joint Protection.

1.2 FIELD QUALITY CONTROL

A. Testing Services: Factory Trained Installer shall test and inspect each automatic entrance to determine compliance of installed systems with applicable ANSI standards.

1.3 REPAIR

A. Repair damaged finish to match original finish.

1.4 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in ANSI/BHMA A156.10.

1.5 CLEANING

A. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Comply with requirements in Section 08 80 00 - Glazing, for cleaning and maintaining glass.

END OF SECTION 08 42 29.43

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed storefront.

B. Aluminum doors and frames.

1.2 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.

B. Section 08 80 00 - Glazing: Glass and glazing accessories.

C. Section 08 44 13 – Glazed Aluminum Curtain Walls

D. Section 08 42 29 - Automatic Entrances

1.3 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

H. ASTM D2244 - Standard Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates; 2011.

I. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007.

J. ASTM D523 - Standard Test Method for Specular Gloss; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least ten years of documented experience. It is the intent of this specification for the same manufacturer to act as a single source supplier for both Aluminum-Framed Storefront (08 43 13) and Glazed Aluminum Curtain Walls (08 44 13).

C. Installer Qualifications: Company specializing in performing the work of this section with minimum ten years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a two year period after Date of Substantial Completion.

C. Manufacturer’s Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 20 years (Painted) and 10 Years (Anodized):
   1. Chalking: No more than that represented by a No.8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

1.10 PERFORMANCE REQUIREMENTS

A. General Performance:
   1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of aluminum storefront systems representing those indicated for this project.
   2. Aluminum storefront systems shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   3. Failure includes any of these events:
      a. Thermal stresses transferring to building structure
      b. Glass breakage
      c. Loosening or weakening of fasteners, attachments, and other components
      d. Failure of operating units

B. Delegated Design:

1. Design aluminum storefront systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads: Per IBC 2021 As Indicated in Structural Drawings

D. Air Leakage:
   1. The test specimen shall be tested in accordance with ASTM E 283.
   2. Air infiltration rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s · m^2) at a static air pressure differential of 6.2 psf (300 Pa).

E. Water Resistance:
   1. The test specimen shall be tested in accordance with ASTM E 331.
   2. There shall be no leakage at a minimum static air pressure differential of 8 psf (383 Pa) as defined in AAMA 501.

F. Uniform Load:
   1. A static air design load of 20 psf (958 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330.
   2. There shall be no deflection in excess of L/175 of the span of any framing member.
   3. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

G. Hurricane Impact Resistance at Exterior Storefront Doors:
   1. Comply with IBC 2021 Code.
   2. Test tested in accordance with ASTM E1886 and information in ASTM E1996, and in TAS-201/203:

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Kawneer (Norcross, GA):

B. Subject to equivalent product design and performance attributes to Basis of Design above as evaluated by the Architect, other potential accepted Aluminum-Framed Storefront and Door manufacturers are as follows:
   1. Wausau Window and Wall Systems (Wausau, WI)
   2. Southern Walls and Windows (New Orleans, LA)
   3. Substitutions: See Section 01 60 00 - Product Requirements. Note: Pre-bid prior approval requests for alternative manufacturers is necessary and requests must include project specific design details (Standard Catalog Details Will Not Be Accepted) indicating compliance with drawings and all associated performance data.

2.2 STOREFRONT FRAMING

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices. Kawneer VersaGlaze 450 Framing System.
   1. Glazing Position: Glass located at Front Plane of System per Details. Both captured details are required as well as Structural Silicone Glazed (SSG) details as indicated on Drawings.

2. Profile Dimensions: 2 inches wide by 4-1/2 inches deep.
3. Finish as Identified on Drawings: Either Architectural Class I complying with AAMA 611, AA-M10C21A41 / AA-M45C22A41 natural anodized or 70% PVDF Fluoropolymer 3-Coat Painted Finish complying with AAMA 2605. Color and Finish to Match Architect Sample or selection.
   a. Factory finish all surfaces that will be exposed in completed assemblies.
4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
5. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
6. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.3 COMPONENTS

A. Aluminum Framing Members: Extruded aluminum sections.

1. Application: Interior Storefront.
2. Frame Size, nominal:
   a. Face Width: 2 inch.
   b. Head, Jamb, Vertical Mullion Depth: 4-1/2 inch.
   c. Glazing Pocket: 5/8 inch
3. Member Wall Thickness, nominal: 0.125 inch.
4. Product: Kawneer VersaGlaze 450 (Front Set).

B. Glazing: As specified in Section 08 80 00 and as identified on Drawings.

C. Interior Doors: Glazed aluminum, Basis of Design Kawneer 190 Narrow Stile.
1. Thickness: 1-3/4 inches.
2. Member Wall Thickness, minimum: 0.125 inch.
3. Top Rail: 3-1/2 inches wide.
4. Vertical Stiles: 3-1/2 inches wide.
5. Bottom Rail: 10 inches wide.
6. Glazing Stops: Square.
7. Finish: Clear Anodized Aluminum and/or Painted as Identified on Drawings.

D. Interior trim, mullion covers, stool extensions: Formed or extruded aluminum, minimum 0.125 inch thickness for framing members, 0.050 inch thickness for glazing stops and similar components.

E. Exterior (Impact Resistant) Doors: Glazed aluminum, Basis of Design Kawneer 350 IR Medium Stile.
1. Thickness: 1-3/4 inches.
2. Member Wall Thickness, minimum: 0.125 inch.
3. Top Rail: 3-1/2 inches wide.
4. Vertical Stiles: 3-1/2 inches wide.
5. Bottom Rail: 10 inches wide.
6. Glazing Stops: Square.
7. Finish: Clear Anodized Aluminum and/or Painted as Identified on Drawings.

E. Transition Assembly: Wherever identified on Drawings or dictated by excessive sealed joint sizes (1-1/4” or greater), Pre-engineered, finished aluminum and silicone materials forming an air and vapor barrier transition assembly for bridging continuously between the window assembly and adjacent air and vapor barrier materials.
1. Product: Proglaze ETA System 1 manufactured by Tremco.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Fasteners: Stainless steel.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

E. Glazing Accessories: As specified in Section 08 80 00.

2.5 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

B. All Aluminum Storefronts located within the natatorium and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure shall receive a Three-Coat Fluoropolymer: AAMA 2605, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' installation instructions.

Painted Finish: 70% PVDF Fluoropolymer 3-Coat Painted Finish complying with AAMA 2605. Color and Finish to Match Architect Sample or selection. See drawings for color selections

C. **No Anodized Finish allowed within the natatorium and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure**

2.6 HARDWARE

A. Door Hardware: For interior storefront doors, as specified in Section 08 71 00 and supplied/delivered by the finish hardware supplier to the storefront door manufacturer's production facility. For exterior storefront doors the hardware will be that which has been tested for hurricane impact and supplied by the door manufacturer and the glazing subcontractor. Continuous hinges, LCN 4040 Surface Closers, Aluminum Thresholds, Manufacturer's Standard Door Bottom Weathering. Regarding locking, the function of door for egress, and/or electronic security locking will be as indicated on drawings and manufacturer will supply suitable impact tested assemblies (ex: impact tested panic devices, MS locking, electronic latch retraction) as may be applicable. Keypad or card access controls will be by the finish hardware supplier or the Owner.

B. Provide 316 stainless steel door hardware for all Storefronts located within the natatorium and in adjacent areas subject to high humidity, elevated temperatures or chlorine/chloramine exposure.

2.7 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

E. Arrange fasteners and attachments to conceal from view.

F. Reinforce framing members for imposed loads.

G. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.

1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

B. Provide alignment attachments and shims to permanently fasten system to building structure.

C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

D. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

B. Test installed storefront for water leakage in accordance with AAMA 501.2 hose test.

C. At Owner's discretion, static water testing of installed assemblies per AAMA 503.3 and ASTM E 1105 can be conducted at 35%, and 50% completion of work. Costs of testing to be borne by the General Contractor and testing conducted by a certified 3rd party testing agency experienced in testing installed glazing system assemblies per test methods identified.

3.5 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.

B. Aluminum Sun-Shading Elements Fixed to Glazed Curtain Wall Systems.

C. Perimeter sealant.

D. Extruded Aluminum Screen Assembly at Main Entrance (See Drawings)

E. Aluminum-framed curtain wall doors

1.2 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Steel attachment members.

B. Section 07 81 00 - Firestopping: Firestop at system junction with structure.

C. Section 07 90 00 - Joint Sealers: Perimeter sealant and back-up materials.

D. Section 08 43 13 – Aluminum-Framed Storefronts

E. Section 08 80 00 - Glazing.

F. Section 08 42 29 Automatic Entrances.

1.3 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 501.1 - Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure; 2005.

C. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products; 2012.

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2015.

F. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.

G. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

N. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2014.

O. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).

P. ASTM C793 - Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants; 2005 (Reapproved 2010).

Q. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015.

R. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

S. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2000 (Reapproved 2011).

T. ASTM C1115 - Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories; 2006 (Reapproved 2011).

U. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2014.

V. ASTM D523 - Standard Test Method for Specular Gloss; 2014.

W. ASTM D4145 - Standard Test Method for Coating Flexibility of Prepainted Sheet; 2010.

X. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

Y. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

Z. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

AA. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

AB. ASTM E413 - Classification for Rating Sound Insulation; 2010.

AC. NFRC 400 - Procedure for Determining Fenestration Product Air Leakage; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers. Review methods and procedures related to glazed aluminum curtain wall systems including, but not limited to the following:
   1. Quality control procedures.
   2. Interface with adjacent work.
   3. Dimensions and tolerances.
   4. Sealant work and testing.
   5. In-place testing.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

C. Shop Drawings: Prepared by system manufacturer. Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
   1. Drawings sealed and signed by Professional Engineer licensed at the State in which the Project is located.

D. Shop Drawings: Provide details of proposed structural sealant glazing (SSG) and weather sealant joints indicating dimensions, materials, bite, thicknesses, profile, and support framing.

E. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified and licensed Louisiana engineer responsible for their preparation.

F. Samples: Submit two samples 3 x 5 inches in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.

G. Specimen Warranty.

H. Structural Sealant Glazing (SSG): Submit product data and calculations or lab/field tests by manufacturer showing compliance with performance requirements.

I. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are potentially acceptable subject to Architect review and approval.
   1. Refer to paragraph 1.7 for further laboratory test report requirements.

J. Design Data: Provide complete calculations on structural aspects of window design and application including framing deflections and stresses, anchor stresses, effects of sunshades, sunshade components and the localized effects as prepared, sealed and signed by a structural engineer licensed at the State in which the Project is located.

K. Field Quality Control Submittals: Report of field testing for water leakage.

L. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

M. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.
   1. Prepare, certify, and submit in 8½" x 11" format a fully coordinated set of calculations that substantiate and justify the compliance of the complete application of the Work with this section including; embeds and inserts, anchors and fasteners, deflections and stresses of framing members and ancillary supports, structural sealant stresses, and consideration of movement and tolerance.

B. Laboratory Mock-Up Testing: Have a specimen representative of project conditions tested by an independent testing agency for compliance with specified performance criteria.

C. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, shelf-life, storage conditions, and color.

D. See Section 01 90 00 Mock-Up Assemblies, for general requirements of on-site visual mock-ups.

E. Installer: Company specializing in performing the work of this section trained in system installation and acceptable to manufacturer.

1.7 LABORATORY MOCK-UP

A. See Section 01 40 00 Quality Requirements, for general requirements for mock-ups.

B. Laboratory Test Reports: The following requirements for laboratory mock-up testing will be waived if manufacturer submits laboratory test reports, on mock-up of a system which, in Architect's opinion, is similar in scope and configuration to specified construction and certifies compliance with Performance Requirements.

C. System supplier shall build and test a laboratory mock-up conforming to actual system configuration (or prior tested assembly if deemed acceptable to Architect), including structural components. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

1. An independent testing laboratory, paid by Contractor shall perform tests.
2. Same supervisor who install system in the Project shall install mock-up.

D. Provide mock-up including all components occurring on project at least one full bay wide by one full floor level high. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

E. Assemble and test mock-up at independent testing laboratory facilities.

F. Notify Owner and Architect seven days in advance of the dates and times when assemblies will be tested.
1. Contractor shall pay travel and per diem costs for Owner, Architect and Consultants to observe laboratory testing when testing is located outside county of project location.

G. Testing Scope: Perform the following mock-up tests in accordance with performance requirements of this Section in the following sequence.
1. Preliminary loading (positive) 50 percent of design load; ASTM E330/E330M, Procedure B.
2. Air Infiltration; ASTM E283.
3. Static Pressure Water Penetration; ASTM E331.
4. Dynamic Pressure Water Penetration; AAMA 501.1.
5. Structural Performance: 50 percent and 100 percent positive, 50 percent and 100 percent negative design load; ASTM E330/E330M, Procedure B.
6. Retest Air Infiltration; ASTM E283.
7. Retest Static Water Penetration; ASTM E331.
8. Structural Overload: 75 percent and 150 percent positive, and 75 percent and 150 percent negative design load; ASTM E330/E330M, Procedure B.
9. Concentrated load testing on facade access equipment stabilization system (If Required) attached to exterior wall framing. Apply outward, inward, and side-loading of magnitude and duration as required by Section 11 24 23.

H. Laboratory Testing Submittals:
1. Before Laboratory Fabrication
   a. Shop Drawings of mock-up.
   b. Test Procedures
2. After Laboratory Testing
   a. Laboratory Test Reports
   b. Record Drawings indicating revisions or corrective measures taken during testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

C. Repair or replace damaged materials as determined by Architect.

1.9 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. See Section 07 90 05 - Joint Sealers and 08 80 00 - Glazing for additional warranty requirements.

C. Correct defective Work within a two year period after Date of Substantial Completion. Warranty work to include materials, labor, equipment and temporary facilities. Failures include, but are not limited to, the following:
   1. Structural failures including, but not limited to, excessive deflection.
   2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   3. Excessive air infiltration through fixed glazing and framed areas.
   4. Water penetration through fixed glazing and framing areas.

D. Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the factory-applied finish will perform as follows for minimum of 20 years (Painted) and/or 10 Years (Anodized):
   1. Chalking: No more than that represented by a No.8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Kawneer (Norcross, GA); Kawneer 1600 Wall System 1 (Captured) and 1600 Wall System 2 Structural Silicone Glazed 2-Sides (SSG):

B. Subject to equivalent product design and performance attributes as evaluated by the Architect to Basis of Design above, other potential accepted Glazed Aluminum Curtain Wall manufacturers are as follows:
   1. Wausau Window and Wall Systems (Wausau, WI)
   2. Oldcastle Building Envelope
   3. Substitutions: See Section 01 25 00 - Product Requirements. Note: Pre-bid prior approval requests for alternative manufacturers is necessary and requests must include project specific design details (Standard Catalog Details Will Not Be Accepted) indicating compliance with drawings and all associated performance data.

2.1A DELEGATED DESIGN PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Louisiana, to design the glazed aluminum curtain wall system, including structural support framing, anchorage, and connections to the building structure, calculations for wind loading in compliance with the performance criteria below.

B. General Performance: Glazed aluminum curtain walls shall be capable of withstanding building movements and weather exposures, including:

   1. Story drift, twist, column shortening, creep, and deflection.
   2. Thermal expansion and contraction.
   3. Dynamic loading, including windborne debris per hurricane requirements.
   4. Structural loading without glass breakage, seal failure, vibration, or component loosening.

C. Deflection of Framing Members:

   1. Normal to wall plane: Limit to L/175 for spans ≤13'-6", and L/240 + 1/4" for spans >13'-6", but no more than 3/4".
   2. Parallel to glazing: Limit to L/360, or maximum reduction of glass bite to 75% and edge clearance not less than 1/8".

3. Cantilever Deflection: Limit to L/175 or L/240 + 1/4" based on span length.

D. Thermal Movement: Accommodate thermal movement resulting from ambient and surface temperature changes:

1. Ambient: 120°F differential.
2. Surface: 180°F differential.

E. Structural Testing: In accordance with ASTM E330/E330M:

1. No deflection exceeding limits at design pressure.
2. No failure or permanent deformation at 150% of design pressure.
3. Test duration: Minimum 10 seconds.

F. Air Infiltration: ASTM E283

1. Maximum 0.06 cfm/sf at 6.24 psf pressure differential.

G. Water Penetration: ASTM E331:

1. No leakage at 15 psf or 20% of design pressure, whichever is greater

H. Energy Performance:

1. NFRC Certified Ratings required for entire system including framing, glazing, and spacers.
2. U-factor: Maximum 0.39 Btu/sf·hr·°F (in accordance with NFRC 100 or AAMA 507).
3. Condensation Resistance: Minimum CRF Frame 66, CRF Glass 60 per AAMA 1503.

I. Impact Resistance (Windborne Debris):

1. Conform to ASTM E1886 and E1996 for Wind Zone 2 (Houma, LA), including:

a. Large missile impact below 30' above grade.

b. Small missile impact between 30'-60'.

J. Acoustic Performance:

1. Minimum STC rating of 37 when tested to ASTM E90.

K. Mock-Up Testing Requirements:

1. Provide full-scale mock-up tested per Section 1.7 and ASTM/AAMA protocols.

2.2 CURTAIN WALL - GENERAL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Fabrication Method: Shop fabricated field installed stick system.
2. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
3. Thermal Isolation: Provide thermal isolation within assembly to separate exterior covers from interior verticals and horizontals to create a thermally improved system.

4. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
5. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Structural Performance Requirements: Design and size components per IBC 2021 As Indicated in Structural Drawings and to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the requirements of ASCE 7.
      a. Member Deflection: Comply with requirements of AAMA TIR-A11:
         1) Limit member deflection to l/175 for spans up to 13'-6" and l/240 + ¼ inch for spans over 13'-6" and maximum of 3/4 inch whichever is less.
         2) For cantilevers, l = 2 times the unsupported span.
         3) In-plane deflection of framing members shall not exceed 1/8 inch or decrease glass bite or clearance by more than 25 percent.
         4) Limit anchor deflection under design load to 1/8 inch maximum.
   2. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
      a. For calculating member stress and similar, adhere to P.E. and Industry Standards for Aluminum, Steel and Fastener components.
      b. Permanent set of framing members shall not exceed l/1000 of clear span when subjected to 1.5 times the maximum design load.
      c. Permanent set of anchors shall not exceed 1/16 inch when subjected to 1.5 times the maximum design load.
   3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Limit deflection of curtain wall perimeter framing to 50 percent of the design dimension.
      d. Deflection of structural support framing, under permanent and dynamic loads.
      e. Curtain wall shall accommodate a total of plus or minus 3/8 inch for both permanent and dynamic movement of the supporting structure including:
         1) Shortening of structural concrete columns.
         2) Creep of structural concrete members.
         3) If expansion or deflection horizontals are required to accommodate deflections, then this responsibility is a design issue (possible increased sight lines to be assessed and decided by the architect) for approval and a cost item to be borne by the bidder.
   4. Structural Sealant Glazing (SSG) System: For individual glass lites, design framing members to not exceed a deflection normal to the wall of L/175 between supports with 3/4 inch maximum, and a deflection parallel to the wall of L/360 with 1/8 inch maximum, whichever is less.

C. Water Penetration Resistance: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 15 lbf/sq ft.
   2. Test Method: ASTM E331.

D. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.2 psf pressure differential across assembly.

E. Thermal Performance U-factor and CRF: The U-factor calculation in accordance with NFRC 100 or AAMA 507, specific for manufacturer's framing. U-factor Maximum .39. CRF when

using AAMA 1503 with standard clear insulated glass the CRF (Frame) and CRF (Glass) shall not be less than 66 and 60 respectfully.

F. Hurricane Impact Resistance
   1. Comply with IBC 2021 Code.
   2. Test tested in accordance with ASTM E1886 and information in ASTM E1996

G. Acoustical Performance Requirements:
   1. Sound Attenuation: Sound Transmission Loss (STC) not to be less than 37 (exterior glass and aluminum assembly), minimum, from exterior to interior.
   2. Test Method: ASTM E90, and ASTM E1425

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2.3 COMPONENTS

A. Basis of Design:
   1. Curtain Wall Type 1:
      a. Basis of Design: 1600 Wall System 1 manufactured by Kawneer.
      b. Sight Line: 2-1/2 inch. Larger Sightlines will not be accepted.
         1) Size as needed at sunscreens..
      c. Depth: (length of sunshade) as indicated on drawings.
      d. Glazing: Outside glazed, Pressure plate and mullion covers 4-sides.
      e. Finish: Superior performance organic coating. Factory finish all surfaces.
   2. Curtain Wall Type 2:
      a. Basis of Design: 1600 Wall System 2 manufactured by Kawneer.
      b. Sight Line: 2-1/2 inch. Larger Sightlines will not be accepted.
      c. Depth: (length of sunshade) as indicated on drawings.
      d. Glazing: Outside glazed, Pressure plate and mullion covers 2 and 4-sides.
      e. Finish: Superior performance organic coating. Factory finish all surfaces.
   3, Curtain Wall Type 3: Natatorium
      a. Basis of Design: 1600 Wall System 1 or 2 manufactured by Kawneer.
      b. Sight Line: 2-1/2 inch. Larger Sightlines will not be accepted.
         1) Size as needed at sunscreens..
      c. Depth: (length of sunshade) as indicated on drawings.
      d. Glazing: Outside glazed, Pressure plate and mullion covers 2 and/or 4-sides.
      e. Finish:
         1. Exterior side of curtain wall: Finish shall meet AAMA 2605 performance requirements. Color/Type: Class 1 anodized, either Clear or Dark Bronze, AAMA 611 Color and finish to match Architect's sample or Selection.
         2. Interior side of curtain wall surfaces exposed to natatorium, lap pool, hydrotherapy, and/or adjacent areas subject to elevated temperatures or chlorine/chloramine exposure: Apply a three-coat fluoropolymer finish complying with AAMA 2605. Finish shall contain not less than 70% PVDF resin by weight in both the color coat and clear topcoat. Prepare, pre-treat, and apply coatings per manufacturer's instructions.

            i. Color and finish selection shall be by the architect from the full range offered by the manufacturer.

         3. Restrictions: No anodized finishes are permitted on interior surfaces within the natatorium or adjacent areas subject to high humidity, elevated temperatures, or chlorine/chloramine exposure.
         4. Factory finish all surfaces that will be exposed in completed assemblies as much as possible.

5. Touch-Up Materials: As recommended by coating manufacturer for field application.

B. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Cross-Section Depth: Overall depth as specified to meet performance requirements.
   2. Structurally Reinforced Members: As may be required, supply extruded aluminum with internal reinforcement of structural steel member.

C. Glazing: As specified in Section 08 80 00.

D. Interior trim, mullion covers, stool extensions: Formed or extruded aluminum, minimum 0.125 inch thickness for framing members, 0.050 inch thickness for glazing stops and similar components.

E. Coping: Formed aluminum, 0.125 inch thick, finish to match curtain wall framing members.

F. Transition Assembly Wherever Identified on Drawings or dictated by excessive joint seal dimensions: Pre-engineered, finished aluminum and silicone materials forming an air and vapor barrier transition assembly for bridging continuously between the window assembly and adjacent air and vapor barrier materials.
   1. Product: Proglaze ETA System 1 manufactured by Tremco: www.tremcosealants.com.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Steel Tubing: ASTM A500/A500M, Grade B cold-formed structural tubing.

D. Structural Steel Sections: ASTM A36/A36M; shop primed.

E. Structural Supporting Anchors: See Section 05 12 00.

F. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.

G. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.

H. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

I. Exposed Flashings: 0.060 inch thick aluminum sheet; finish to match framing members.

J. Concealed Flashings: 0.018 inch thick stainless steel.

K. Firestopping: As specified in Section 07 84 00.

L. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
   1. SSG adhesive in compliance with ASTM C920; Type M - Multicomponent, Grade NS, Class 50, Use NT, G, and A.
   2. Ultimate Tensile Strength: Minimum of 50 psi as determined by test method ASTM C1135 under the following conditions.
      a. Exposure to air temperatures of 190 degrees F and minus 20 degrees F.
      b. Water immersion for seven (7) days, minimum.
      c. Exposure to weathering for 5,000 hours, minimum.
   3. Sealant Design Tensile Strength: 20 psi, maximum.
   4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.

5. Color: Black.
6. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.
7. Manufacturers:
   a. Dow Corning Corporation; Structural Glazing Sealants: www.dowcorning.com/construction/sle.
   b. Momentive Performance Materials, Inc, exclusive licensee of General Electric:
   c. Tremco Inc;
   d. Substitutions: See Section 01 60 00 - Product Requirements.

M. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; type recommended by structural sealant glazing (SSG) adhesive manufacturer.

N. Perimeter Sealant: Type silicone specified in Section 07 90 05.

O. Glazing: As specified in Section 08 80 00.

P. Glazing Gaskets: Per curtain wall manufacturer standard material; silicone, EPDM, or SCR.

Q. Glazing Accessories: As specified in Section 08 80 00 and consistent with curtain wall manufacturer standard material.

R. Shop and Touch-Up Primer for Steel Components: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.

2.5 CURTAIN WALL DOORS

A. Manufacturers:

1. Basis of Design: Door shall be Kawneer 350 Medium Stile Door or approved equal.
2. Acceptable Manufacturers:
   a. Southern Walls and Windows (New Orleans, LA)
   b. YKK AP America
   c. Oldcastle Building Envelope

B. Door Construction:

1. Type: Medium- or wide-stile glazed aluminum entrance door.
2. Configuration: [Single leaf] or [pair], as indicated on Drawings.
3. Frame Compatibility: Fully compatible with curtain wall framing system.
4. Stile Dimensions:
   a. Medium Stile: Approximately 3-1/2 inches
   b. Wide Stile: Approximately 5 inches
5. Rail Dimensions:
   a. Top Rail: Minimum 3-1/2 inches
   b. Bottom Rail: Minimum 10 inches, ADA-compliant
6. Glazing: Match curtain wall system glazing, wet or dry glazed.
7. Corner Construction: Mortise and tenon with mechanical fasteners and reinforcing brackets.

C. Materials and Finish:

1. Aluminum: 6063-T6 extruded aluminum alloy.
2. Finish:
   a. To meet AAMA 2605 performance requirements.Color/Type: Class 1 anodized, either clear or Dark Bronze, per AAMA 611.

b. All door surfaces exposed to natatorium, lap pool, hydrotherapy, and/or adjacent areas subject to elevated temperatures or chlorine/chloramine exposure: Apply a three-coat fluoropolymer finish complying with AAMA 2605. Finish shall contain not less than 70% PVDF resin by weight in both the color coat and clear topcoat. Prepare, pre-treat, and apply coatings per manufacturer's instructions.

i. Color and finish selection shall be by the architect from manufacturer's full range.

c. Restrictions: No anodized finishes are permitted within the natatorium or adjacent areas subject to high humidity, elevated temperatures, or chlorine/chloramine exposure.

D. Hardware:

1. Door hardware shall be fully compatible with curtain wall framing and coordinated with Division 08 Section "Door Hardware."

2. Standard hardware includes:

a. Continuous geared hinge

b. Concealed or surface closer (low-profile)

c. Pulls or push/pull hardware sets

d. Lockset: Mortise lock with minimum 1" throw deadbolt

e. Threshold: ADA-compliant, thermally broken where required

f. Weatherstripping: Perimeter compression-type

g. Hardware exposed to natatorium, lap pool, hydrotherapy, and/or adjacent areas subject to elevated temperatures or chlorine/chloramine exposure to be 316 Stainless steel.

E. Performance:

1. Air Infiltration: Not more than 0.50 cfm/sq. ft. at 6.24 psf per ASTM E283.

2. Water Penetration Resistance: No leakage at 10 psf per ASTM E331.

3. Structural: Minimum 30 psf positive and negative wind load per ASTM E330.

4. Thermal Break: Thermally improved framing, when used in thermally broken curtain wall assemblies.

5. ADA Compliance: Door system, hardware, and threshold to comply with ICC A117.1 and ADA Standards.

F. Accessories:

1. Panic hardware (where required by code).

2. Electrified hardware provisions (coordinate with Division 28).

3. Closers and pivots for integration with curtain wall transom frames.

4. Kick plates and push plates (as required).

a. Factory finish all surfaces that will be exposed in completed assemblies.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.6 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and waterproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

E. Arrange fasteners and attachments to conceal from view to greatest extent possible.

F. Reinforce interior horizontal head rail to receive blind brackets and attachments.

G. Reinforce framing members for imposed loads.

H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. To greatest extent possible, touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Separate dissimilar metals. Use gasketed fasteners where required to eliminate possibility of corrosive or electrolytic action between metals.

E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

F. Provide thermal isolation where components penetrate or disrupt building insulation.

G. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

H. Install transition assembly. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Coordinate the work with installation of perimeter fire-containment systems (firestopping components) in Section 07 81 00 and sheet metal closure plate as indicated on the drawings.

J. If required by work of this Section, Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

K. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 08 80 00, using exterior dry glazing method.

L. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions.

M. Install perimeter sealant in accordance with Section 07 90 05 Joint Sealers.

N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired as determined by Architect.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 1 inch and minimum of 1/2 inch. Exception based on construction tolerances and based on building movement and thermal expansion (to be reviewed by Architect).

3.4 FIELD QUALITY CONTROL

A. Provide the services of the installer's field representative to observe installation and make report. Conduct observations at 25, 50 and 100 percent of installation.

B. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

C. General Contractor shall employ and pay for services of an independent testing agency to perform specified testing.

D. Make available to testing laboratory for conducting testing, scaffolding, rigging and incidental equipment as required to access the test specimens.

E. Test installed curtain wall for water leakage in accordance with AAMA 503.3 and ASTM E 1105 at uniform test pressure difference of 12 lbf/sq ft (no field/site pressure reduction allowed).
   1. In accordance with AAMA 502 testing to be performed by an AAMA accredited independent testing agency.

F. Test Specimens: Minimum of three panels (4 mullions) wide by one floor high (top of floor to top of floor).
   1. Conduct 4 series of tests; separate test units per phase.
      a. 1 test to be conducted after plus/minus 5 percent of glazing has been installed. Do not proceed with installation if test fails.
      b. 1 test unit at plus/minus 25 percent of installation
      c. 1 test unit at plus/minus 50 percent of installation
      d. 1 test unit at plus/minus 100 percent of installation

G. Test Specimen Failure:
   1. Water penetration and test procedures shall be as defined in AAMA 503.3 and ASTM E 1105 procedures
   2. Replace curtain wall components that have failed field testing and retest until performance is satisfactory.
      a. In addition to retesting failed specimen, perform additional new test at location designated by Architect.
   3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
      a. Retesting costs to include fees and expenses incurred by Owner, Architect and Consultants.
   4. Once deficiencies are corrected in the tested work, make corrections to the balance of the work to ensure that all work complies with the performance criteria.

H. Test Report: Prepare written test report and promptly to Contractor and Architect.

3.5 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

D. Replace any portion of glazed curtain wall system that cannot be cleaned and repaired to the Architect's satisfaction.

3.6 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Stainless Steel Doors and Frames”.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section “Radiation Shielding Doors and Frames”.
5. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
6. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI/SDI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swing Door Assemblies.
3. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
4. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure difference.
5. ASTM E1996 - Standard specification for performance of exterior windows, curtain walls, doors and storm shutters impacted by Windborne Debris in Hurricanes.
6. ICC/IBC - International Building Code.
7. NFPA 70 - National Electrical Code.
8. NFPA 80 - Fire Doors and Windows.
9. NFPA 101 - Life Safety Code.
10. NFPA 105 - Installation of Smoke Door Assemblies.
11. TAS-201-94 - Impact Test Procedures.

12. TAS-202-94 - Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components using Uniform Static Air Pressure.
13. TAS-203-94 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
14. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access

control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Hurricane Resistant Openings: Exterior hurricane opening assemblies to be tested according to ASTM E330, ASTM E1886, ASTM E1996, TAS 201, TAS 202, TAS 203 standards, and certified by a qualified independent third party agency acceptable to authority having jurisdiction, with labeling indicating compliance with the design pressure and debris impact resistance level requirements specified for the Project.
2. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Please be advised that Hardware Supplier and Hardware Installer must obtain a license with the Louisiana Office of State Fire Marshall in accordance to RS 40:1464 and RS 40:1664.

B. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

C. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

D. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

E. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

G. Hurricane Resistant Exterior Openings: Provide exterior door hardware as complete and tested assemblies, or component assemblies, including approved doors and frames specified under Section 081113 "Hollow Metal Doors and Frames", to meet the design pressures, debris impact resistance, and glass and glazing requirements applicable to the Project.
1. Test units according to ASTM E330, ASTM E1886, ASTM E1996, TAS 201, TAS 202, and TAS 203 standards, certified by a qualified independent third party listing agency acceptable to authority having jurisdiction, and bearing a third party certification agency permanent label indicting windstorm approved product.

H. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

I. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

J. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.

5. Review the required inspecting, testing, commissioning, and demonstration procedures

K. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
   1. Quantity: Provide the following hinge quantity:
      a. Two Hinges: For doors with heights up to 60 inches.
      b. Three Hinges: For doors with heights 61 to 90 inches.
      c. Four Hinges: For doors with heights 91 to 120 inches.
      d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
   2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
      a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
      b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.
   3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
      a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
      b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
   4. Hinge Options: Comply with the following:
      a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
   5. Manufacturers:
      a. Hager Companies (HA) - BB Series, 5-knuckle.
      b. Ives (IV) - 5BB Series, 5-knuckle.
      c. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
   1. Manufacturers:.
      a. Hager Companies (HA).
      b. Ives (IV).
      c. Pemko (PE).

2.4 FLOOR CLOSERS AND PIVOTS

A. Pivots: ANSI/BHMA A156.4, Grade 1; space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.
   1. Manufacturers:
      a. Ives (IV).
      b. Norton Rixson (RF).

2.5 POWER TRANSFER DEVICES

A. Electrified Quick Connect Continuous Geared Transfer Hinges: Provide electrified transfer continuous geared hinges with a removable service panel cutout accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
   1. Manufacturers:
      a. Ives (IV) - Connect.
      b. Pemko (PE) - SER-QC (# wires) Option.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
   1. Provide one each of the following tools as part of the base bid contract:
      a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
      b. McKinney (MK) - Connector Hand Tool: QC-R003.
   2. Manufacturers:
      a. Hager Companies (HA) - Quick Connect.
      b. McKinney (MK) - QC-C Series.
      c. Schlage (SC) - Connect.

2.6 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
   1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
   2. Furnish dust proof strikes for bottom bolts.
   3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:
   a. Burns Manufacturing (BU).
   b. Ives (IV).
   c. Rockwood (RO).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
1. Manufacturers:
   a. Burns Manufacturing (BU).
   b. Ives (IV).
   c. Rockwood (RO).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:
   a. Burns Manufacturing (BU).
   b. Ives (IV).
   c. Rockwood (RO).

2.7 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:
   a. Match Existing, Field Verify.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.

4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

F. Construction Keying: Provide construction master keyed cylinders.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.8 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Manufacturers:
   a. Lund Equipment (LU).
   b. MMF Industries (MM).
   c. Telkee (TK).

2.9 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
1. Manufacturers:
   a. Corbin Russwin Hardware (RU) - ML2000 Series.
   b. Sargent Manufacturing (SA) - 8200 Series.
   c. Schlage (SC) - L9000 Series.

2.1 INTEGRATED WIRED OUTPUT LOCKING DEVICES - MULTI-CLASS READER

A. Integrated Wired Output Multi-Class Mortise Locks: Wiegand or Open Supervised Device Protocol (OSDP) output ANSI A156.13, Grade 1, mortise lockset with integrated card reader with or without keypad option, request-to-exit signaling, door position status switch, and latchbolt monitoring in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim, 3/4" deadlocking anti-friction latch, and 1" case-hardened steel deadbolt. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Latchbolt monitoring and door position switch act in conjunction to report door-in-frame (DPS) and door latched (door closed and latched) conditions.
2. Integrated reader supports the following credentials:
    a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
    b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
    c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
    d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
    e. NFC-enabled mobile phones
    f. PIN code only or PIN + credential with keypad option.
3. 12VDC external power supply required for reader and lock, with optional 24VDC lock solenoid. Fail safe or fail secure options.
4. Energy Efficient Design: Provide lock bodies which have a holding current draw of 500mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
5. Support end-of-line resistors contained within the lock case.
6. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
7. Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.
8. Manufacturers:
    a. Sargent Manufacturing (SA) - SN200/SN210 8200 Series.
    b. No Substitution.

2.2 DEADLOCKS AND LATCHES

A. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8” diameter bolts.

1. Manufacturers:
    a. Adams Rite Manufacturing (AD) - MS1850S / MS1950 Series.
    b. Adams Rite Manufacturing (AD) - 4900 Series.

2.3 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   1. Strikes for Mortise Locks and Latches: BHMA A156.13.
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

2.4 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
   1. Exit devices shall have a five-year warranty.
   2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
   3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
   4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
   5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
   6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
      a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
      b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
   7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
   8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
   9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
   10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
   11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
   1. Manufacturers:
      a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
      b. Sargent Manufacturing (SA) - 80 Series.
      c. Von Duprin (VD) - 35A/98 XP Series.

2.5 INTEGRATED WIRED OUTPUT EXIT DEVICES - MULTI-CLASS READER

A. Integrated Wired Output Multi-Class Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated card reader with or without keypad option, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.
   1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
   2. Integrated reader supports the following credentials:
      a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
      b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
      c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
      d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
      e. NFC-enabled mobile phones
      f. PIN code only or PIN + credential with keypad option
   3. 12VDC external power supply required for reader. 24VDC required for solenoid operated exit trim. Fail safe or fail secure options.
   4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
   5. Competitor Alternates Allowed Option: Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.
   6. Manufacturers:
      a. Sargent Manufacturing (SA) - SN200/SN210 80 Series.
      b. No Substitution.

2.6 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC6000 Series.
b. LCN Closers (LC) - 4040 Series.
c. Sargent Manufacturing (SA) - 351 Series.

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.
1. Manufacturers:
a. Corbin Russwin (RU) - DC5000 Series.
b. Norton Rixson (NO) - 2800ST Series.
c. Sargent Manufacturing (SA) - 422 Series.

2.7 SURFACE MOUNTED CLOSER HOLDERS

A. Electromagnetic Door Holders: ANSI A156.15, Grade 1 electromagnetic door holder/releases with a minimum 25 to 40 pounds holding power and fail-safe operation; power failure releases door to close.
1. Manufacturers:
a. Norton Rixson (RF) - 900 Series.
b. Sargent Manufacturing (SA) - 1560 Series.

2.8 ARCHITECTURAL TRIM

A. Door Protective Trim
   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
   3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
   4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
      a. Stainless Steel: 300 grade, 050-inch thick.
   5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
   6. Manufacturers:
      a. Ives (IV).
      b. Rockwood (RO).
      c. Trimco (TC).

2.9 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
   1. Manufacturers:
      a. Ives (IV).
      b. Rockwood (RO).
      c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
   1. Manufacturers:
      a. Norton Rixson (RF).
      b. Rockwood (RO).
      c. Sargent Manufacturing (SA).

2.10 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

   1. National Guard Products (NG).
   2. Pemko (PE).
   3. Reese Enterprises, Inc. (RE).

2.11 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
   1. Manufacturers:
      a. Security Door Controls (SD) - DPS Series.
      b. Securitron (SU) - DPS Series.

B. Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
   1. Power supplies shall meet all functions and features as specified herein.
      a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
      b. Tolerates brownout or overvoltage input ± 15% of nominal voltage.
      c. Thermal shutdown protection with auto restart.
      d. Circuit breaker protection against overcurrent and reverse battery faults.
      e. Integrated battery charging circuit to prevent overvoltage on locking devices.
      f. Available with a single relay fire trigger or individually triggered relayed outputs.

g. Monitoring options as specified.

2. Manufacturers:
   a. Securitron (SU) - AQD Series.

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
   1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
   2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
   3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
   4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

   1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   1. Quantities listed are for each pair of doors, or for each single door.
   2. The supplier is responsible for handing and sizing all products.
   3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
   4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RF - Rixson
4. RO - Rockwood
5. SA - SARGENT
6. AD - Adams Rite
7. SU - Securitron
8. BE - BEST Locks & Closers
9. KA - Kaba Ilco
10. OT - Other

Hardware Sets based on undated plans plotted 9/24/2025

Set: 1.0
Doors: 1401, S031
Description: Ext - Alum Pair - Rim/NL - KRM - Card Reader - Closer/stop

2	Continuous Hinge	_FM__SLF-HD1 SERxx		PE	⚡
1	Removable Mullion	L980A	US28	SA	
1	Rim Exit, Nightlatch	72 53 55 56 AD8504 Less Pull	US32D	SA	⚡
1	Rim Exit, Exit Only	53 55 AD8510 EO	US32D	SA	⚡
1	Cylinder	72-as req	626	BE	
2	Perm Core	as req	626	BE	
2	Offset Door Pull	RM7220-36 Mtg-Type 12HD	US32D	RO	
2	Surface Closer	351 CPS	EN	SA	
1	Mullion Gasketing	5110BL		PE	
2	Sweep	315CN		PE	
1	Threshold	2005AT		PE	
2	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
2	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Card Reader	By security provider		OT	
2	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡

Notes: Weatherstripping by Door manufacturer.

Coordinate voltage, operation and electrical characteristics with all related trades.
Hardware products meet Windstorm design intent. Confirm hardware meets Windstorm assembly requirements per aluminum door manufacturer which may differ from what was used for specification. Confirm all hardware compatibility with aluminum storefront manufacturer.

Set: 2.0
Doors: 1520, S011A
Description: Ext - Alum Sgl - Rim/NL - Card Reader - Closer/stop

1	Continuous Hinge	_FM__SLF-HD1 SERxx		PE	⚡
1	Rim Exit, Nightlatch	72 53 55 56 AD8504 Less Pull	US32D	SA	⚡
1	Cylinder	72-as req	626	BE	
1	Perm Core	as req	626	BE	
1	Offset Door Pull	RM7220-36 Mtg-Type 12HD	US32D	RO	
1	Surface Closer	351 CPS	EN	SA	
1	Sweep	315CN		PE	
1	Threshold	2005AT		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Card Reader	By security provider		OT	

1	Position Switch	DPS-M-BK		SU
1	Power Supply	AQD series		SU
1	Gasketing	By the frame manufacturer		OT

Notes: Hardware products meet Windstorm design intent. Confirm hardware meets Windstorm assembly requirements per aluminum door manufacturer which may differ from what was used for specification. Confirm all hardware compatibility with aluminum storefront manufacturer.

Weatherstripping by Door manufacturer.

Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 3.0
Doors: 1700B
Description: Ext - Pair - Rim/NL - KRM - Card Reader - Closer/stop

2	Continuous Hinge	CFM__HD1 SERxx		PE
1	Mullion	HCL980 (12- as req)	PC	SA
1	Rim Exit Device, Storeroom	HC 53 55 56 72 8804 Less Pull	US32D	SA
1	Rim Exit Device, Exit Only	HC 53 55 8810 EO	US32D	SA
1	Cylinder	72-as req	626	BE
2	Perm Core	as req	626	BE
2	Offset Door Pull	RM7220-36 Mtg-Type 12HD	US32D	RO
2	Surface Closer	351 CPS	EN	SA
1	Mullion Gasketing	5110BL		PE
1	Gasketing	2891APK		PE
2	Sweep	315CN		PE
1	Threshold	2005AT		PE
2	ElectroLynx Harness	QC-Cxxx sized for door width		MK
2	ElectroLynx Harness	QC-C1500P		MK
1	Card Reader	By security provider		OT
2	Position Switch	DPS-M-BK		SU
1	Power Supply	AQD series		SU

Notes:

Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 3.1
Doors: S091B
Description: Ext - Rated Pair - Rim/NL - KRM - Card Reader - Closer/stop

2	Continuous Hinge	CFM__HD1 SERxx		PE
1	Mullion	HCL980 (12- as req)	PC	SA
1	Rim Exit Device, Exit Only	HC 12 53 55 8810 EO	US32D	SA
1	Rim Exit Device, Storeroom	12HC 53 55 56 72 8804 Less Pull	US32D	SA

1	Cylinder	72-as req	626	BE	
2	Perm Core	as req	626	BE	
2	Offset Door Pull	RM7220-36 Mtg-Type 12HD	US32D	RO	
2	Surface Closer	351 CPS	EN	SA	
1	Mullion Gasketing	5110BL		PE	
1	Gasketing	2891APK		PE	
2	Sweep	315CN		PE	
1	Threshold	2005AT		PE	
2	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
2	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Card Reader	By security provider		OT	
2	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡

Notes:

Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 4.0
Doors: S081
Description: Ext - Sgl- Rated Rim/NL -Card Reader - Closer/stop

1	Continuous Hinge	CFM__HD1 SERxx		PE	⚡
1	Rim Exit Device, Storeroom	12HC 53 55 56 72 8804 Less Pull	US32D	SA	⚡
1	Perm Core	as req	626	BE	
1	Offset Door Pull	RM7220-36 Mtg-Type 12HD	US32D	RO	
1	Surface Closer	351 CPS	EN	SA	
1	Gasketing	2891APK		PE	
1	Sweep	315CN		PE	
1	Threshold	2005AT		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Card Reader	By security provider		OT	
1	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 4.1
Doors: 1703
Description: Ext - Sgl- Rim/NL -Card Reader - Closer/stop

1	Continuous Hinge	CFM__HD1 SERxx		PE	⚡

1	Rim Exit Device, Storeroom	HC 53 55 56 72 8804 Less Pull	US32D	SA	⚡
1	Perm Core	as req	626	BE	
1	Offset Door Pull	RM7220-36 Mtg-Type 12HD	US32D	RO	
1	Surface Closer	351 CPS	EN	SA	
1	Gasketing	2891APK		PE	
1	Sweep	315CN		PE	
1	Threshold	2005AT		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Card Reader	By security provider		OT	
1	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 5.0
Doors: 0108, 1711
Description: Ext - Pair - Storeroom - MFB - Closer/stop

2	Continuous Hinge	CFM__HD1		PE	
2	Surface Bolt	988	Bright Zinc		SA
1	Storeroom Deadbolt Lock	72 8251 LNNJ	US32D	SA	
1	Perm Core	as req	626	BE	
1	Surf Overhead Stop	9-X36	630	RF	
1	Surface Closer	351 PS	EN	SA	
1	Astragal	By the door manufacturer		OT	
1	Rain Guard	346C		PE	
1	Gasketing	2891APK		PE	
2	Sweep	315CN		PE	
1	Threshold	2005AT		PE	

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 6.0
Doors: 1413B
Description: Ext - Pair - Access Control - MFB - Closer - Inswing

1	Continuous Hinge	CFM__HD1		PE	
1	Continuous Hinge	CFM__HD1 SERxx		PE	⚡
2	Surface Bolt	988	Bright Zinc		SA
1	Access Control Mort Lock w/DB	72 SN200-82281 LNNJ	US26D	SA	⚡
1	Perm Core	as req	626	BE	
1	Surf Overhead Stop	9-X36	630	RF	
1	Surface Closer	351 UO	EN	SA	

1	Astragal	3572SP		PE	
1	Rain Guard	346C		PE	
1	Gasketing	2891APK		PE	
2	Sweep	315CN		PE	
1	Threshold	2005AT		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
2	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 7.0
Doors: 4000C
Description: Ext - Pair - Access Control - MFB - Closer - Outswing

1	Continuous Hinge	CFM__HD1		PE	
1	Continuous Hinge	CFM__HD1 SERxx		PE	⚡
2	Surface Bolt	988	Bright Zinc		SA
1	Access Control Mort Lock w/DB	72 SN200-82281 LNNJ	US26D	SA	⚡
1	Perm Core	as req	626	BE	
1	Surf Overhead Stop	9-X36	630	RF	
1	Surface Closer	351 CPS	EN	SA	
1	Astragal	3572SP		PE	
1	Rain Guard	346C		PE	
1	Gasketing	2891APK		PE	
2	Sweep	315CN		PE	
1	Threshold	1715A		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
2	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 7.1
Doors: 1308B
Description: Ext - Pair - Access Control - MFB - Closer - Outswing - Coated

1	Continuous Hinge	CFM__HD1		PE	
1	Continuous Hinge	CFM__HD1 SERxx		PE	⚡
2	Surface Bolt	988	Bright Zinc		SA
1	Access Control Mort Lock	CPC 72 SN200-82281 LNNJ	US26D	SA	⚡
1	Perm Core	as req	626	BE	

1	Surf Overhead Stop	9-X36	630	RF	
1	Surface Closer	351 CPS	EN	SA	
1	Astragal	3572SP		PE	
1	Rain Guard	346C		PE	
1	Gasketing	2891APK		PE	
2	Sweep	315CN		PE	
1	Threshold	1715A		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
2	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 8.0
Doors: 1309A, 1714, 3007B, 3011B, 4000A, 4000B
Description: Ext - Sgl - SN200/FSE Lock - Closer/stop

1	Continuous Hinge	CFM__HD1 SERxx		PE	⚡
1	Access Control Mort Lock w/DB	72 SN200-82281 LNNJ	US26D	SA	⚡
1	Perm Core	as req	626	BE	
1	Surface Closer	351 CPS	EN	SA	
1	Gasketing	2891APK		PE	
1	Sweep	315CN		PE	
1	Threshold	2005AT		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Card Reader	By security provider		OT	
1	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD Series		SU	⚡

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Coordinate voltage, operation and electrical characteristics with all related trades.

Card Reader, wiring and connections by security provider.

Set: 9.0
Doors: 1710
Description: Ext - Sgl - Storeroom - Closer - Inswing

1	Continuous Hinge	CFM__HD1		PE
1	Storeroom Deadbolt Lock	72 8251 LNNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	422 CTB2	EN	SA

1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Rain Guard	346C		PE
1	Gasketing	2891APK		PE
1	Sweep	315CN		PE
1	Threshold	1715A		PE

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 10.0
Doors: 0105
Description: Ext - Sgl - Storeroom - Closer/stop

1	Continuous Hinge	CFM__HD1		PE
1	Storeroom Deadbolt Lock	72 8251 LNNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 CPS	EN	SA
1	Rain Guard	346C		PE
1	Gasketing	2891APK		PE
1	Sweep	315CN		PE
1	Threshold	2005AT		PE

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 11.0
Doors: 1309, 1310
Description: Ext - Sgl - Storeroom - Closer/stop - Coated

1	Continuous Hinge	CFM__HD1		PE
1	Storeroom Deadbolt Lock	CPC 72 8251 LNNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 CPS	EN	SA
1	Rain Guard	346C		PE
1	Gasketing	2891APK		PE
1	Sweep	315CN		PE
1	Threshold	2005AT		PE

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 12.0
Doors: 0100A, 0104, 1405B, 1705
Description: Ext - Sgl - Rim/Storeroom - Closer/stop - KP

1	Continuous Hinge	CFM__HD1		PE
1	Rim Exit Device, Storeroom	HC 72 8804 ETNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 CPS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Rain Guard	346C		PE
1	Gasketing	2891APK		PE
1	Sweep	315CN		PE
1	Threshold	2005AT		PE

Notes: Hardware meets Windstorm design intent as tested in an assembly. Confirm hardware meets Windstorm assembly requirements per door manufacturer.

Set: 13.0
Doors: 1405A, 1408A
Description: Alum Pair - CVR/Lever - Closer/stop

2	Continuous Hinge	_FM__SLF-HD1		PE
2	CVR Exit, Classroom	72 AD8413 ETNJ	US32D	SA
2	Perm Core	as req	626	BE
2	Surface Closer	351 PS	EN	SA
1	Gasketing	By the frame manufacturer		OT

Set: 14.0
Doors: 1300
Description: Alum Pair - CVR/Lever - Closer/stop - coated

2	Continuous Hinge	_FM__SLF-HD1		PE
2	Concealed Vert Rod Exit, Classroom	CPC 72 AD8413 ETNJ	US32D	SA
2	Perm Core	as req	626	BE
2	Surface Closer	351 PS	EN	SA
1	Gasketing	By the frame manufacturer		OT

Notes: Vapor / Smoke seal where required is by the door manufacturer.

Set: 15.0
Doors: 2201C, 2201D, 2202C, 2202D
Description: Alum Pair - CVR/Lever - Closer / Hold Open

2	Continuous Hinge	_FM__SLF-HD1		PE
2	CVR Exit, Classroom	72 AD8413 ETNJ	US32D	SA
2	Perm Core	as req	626	BE
2	Surface Closer w/ hold open	351 PSH	EN	SA
1	Gasketing	By the frame manufacturer		OT

Set: 16.0
Doors: 1305B
Description: Int - Alum Pair - Rim/NL - KRM - Card Reader - Closer/stop

2	Continuous Hinge	_FM__SLF-HD1 SERxx		PE	⚡
1	Removable Mullion	L980A	US28	SA	
1	Rim Exit, Nightlatch	72 53 55 56 AD8504 Less Pull	US32D	SA	⚡
1	Rim Exit, Exit Only	53 55 AD8510 EO	US32D	SA	⚡
1	Cylinder	72-as req	626	BE	
2	Perm Core	as req	626	BE	
2	Offset Door Pull	RM7220-36 Mtg-Type 12HD	US32D	RO	
2	Surface Closer	351 CPS	EN	SA	
2	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
2	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Card Reader	By security provider		OT	
2	Position Switch	DPS-M-BK		SU	⚡
1	Power Supply	AQD series		SU	⚡
1	Gasketing	By the frame manufacturer		OT	

Notes:
Weatherstripping by Door manufacturer.

Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 17.0
Description: Not Used - Alum Pair - Push/Pull - Deadlock - MFB - Closer/stop

2	Continuous Hinge	_FM__SLF-HD1		PE
2	Flush Bolt	555 / 557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Deadlock	MS1850S	628	AD
1	Cylinder	72-as req	626	BE
1	Thumbturn Cylinder	ADA7161	26D	KA
1	Perm Core	as req	626	BE
2	Push Bar	RM7212 Mtg-Type 12XHD	US32D	RO
2	Straight Door Pull	RM7210-36 Mtg-Type 12HD	US32D	RO
2	Surface Closer	351 PS	EN	SA
1	Gasketing	By the frame manufacturer		OT

Set: 18.0
Description: Not Used - Alum Sgl- Push/Pull - Deadlock - Closer

1	Continuous Hinge	_FM__SLF-HD1		PE
1	Mortise Deadlock	MS1850S	628	AD
1	Cylinder	72-as req	626	BE
1	Thumbturn Cylinder	ADA7161	26D	KA
1	Perm Core	as req	626	BE
1	Push Bar	RM7212 Mtg-Type 12XHD	US32D	RO
1	Straight Door Pull	RM7210-36 Mtg-Type 12HD	US32D	RO
1	Surface Closer	351 UO	EN	SA
1	Gasketing	By the frame manufacturer		OT

Notes: Confirm hardware compatibility with aluminum door manufacturer.

Set: 18.1
Doors: 2200A, 2200B
Description: Alum Pair - Push/Pull - Deadlock - MFB - Closer - EMHO

2	Continuous Hinge	_FM__SLF-HD1		PE
2	Flush Bolt	555 / 557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Deadlock	MS1850S	628	AD
1	Cylinder	72-as req	626	BE
1	Thumbturn Cylinder	ADA7161	26D	KA
1	Perm Core	as req	626	BE
2	Push Bar	RM7212 Mtg-Type 12XHD	US32D	RO
2	Straight Door Pull	RM7210-36 Mtg-Type 12HD	US32D	RO
2	Surface Closer	351 UO	EN	SA
2	Electromagnetic Holder	998M x Voltage	689	RF
1	Gasketing	By the frame manufacturer		OT

Notes: Confirm hardware compatibility with aluminum door manufacturer.
Doors are magnetically held open and must be tied in to fire control. Upon loss of power or signal from fire control doors will close and latch. Power and wiring is by others.

Set: 19.0
Doors: 1301A, 1327, 1328
Description: Alum Sgl - Push/Pull - Closer

1	Continuous Hinge	_FM__SLF-HD1		PE
1	Push Bar	RM7212 Mtg-Type 12XHD	US32D	RO
1	Straight Door Pull	RM7210-36 Mtg-Type 12HD	US32D	RO
1	Surface Closer	351 UO	EN	SA
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing	By the frame manufacturer		OT

Notes: Gasketing / Vapor barrier is by the door manufacturer.

Set: 20.0
Description: Alum Sgl - Push/Pull - Closer/stop

1	Continuous Hinge	_FM__SLF-HD1		PE
1	Push Bar	RM7212 Mtg-Type 12XHD	US32D	RO
1	Straight Door Pull	RM7210-36 Mtg-Type 12HD	US32D	RO
1	Surface Closer	351 PS	EN	SA
1	Gasketing	By the frame manufacturer		OT

Set: 20.2
Doors: 1313

Description: Alum Sgl- Push/Pull - Deadlock - Closer

1	Continuous Hinge	_FM__SLF-HD1		PE
1	Mortise Deadlock	MS1850S	628	AD
1	Cylinder	72-as req	626	BE
1	Thumbturn Cylinder	ADA7161	26D	KA
1	Perm Core	as req	626	BE
1	Push Bar	RM7212 Mtg-Type 12XHD	US32D	RO
1	Straight Door Pull	RM7210-36 Mtg-Type 12HD	US32D	RO
1	Surface Closer	351 UO	EN	SA
1	Gasketing	By the frame manufacturer		OT

Notes: Confirm hardware compatibility with aluminum door manufacturer.

Set: 21.0
Doors: 2200
Description: Dbl Egress - Exit Device-EO/EO - Closer w/HD-PA - (1) DE Mag Lock - Access Control

2	Continuous Hinge	CFM__HD1 SERxx		PE
1	Magnetic Lock	DEM680E	630	SU
2	Surface Vert Rod Exit	55 NB8710	US32D	SA
2	Closer	351 P10	EN	SA
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	W/F Stop	406 / 441CU	US26D	RO
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK
1	Frame Wire Harness	QC-C1500P		MK
1	Card Reader	By security provider		OT
1	Position Switch	DPS-M/W-BK (as req'd per app)		SU
1	Power Supply	AQD series		SU

Notes: Operation. Non-Secure egress door normally closed and locked by delay egress electromagnetic lock. Authorized egress by valid card at the reader bypasses the delayed egress electromagnetic lock for egress. Unauthorized egress by depressing the exit device and pushing on the door initiates an irreversible alarm and 15 second delay. After 15 seconds the electromagnetic lock releases for egress. Free egress from the secure side by depressing the exit device rail. Must be tied to an approved fire alarm system. Activation of the fire alarm or signal from fire command shunts power to the delayed egress electromagnetic lock for immediate egress. Door status monitored.

Set: 22.0
Doors: 2300A, 2300B
Description: Pair - SVR/SN200 - Closer - KP

4	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
2	Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx	US26D	MK
1	SVR Exit, SN200	72 SN200-8773 ETNJ	US32D	SA
1	SVR Exit, SN200	72 SN200-8773 306 x ETNJ	US32D	SA
1	Perm Core	as req	626	BE
2	Surface Closer	351 UO	EN	SA

2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	W/F Stop	406 / 441CU	US26D	RO
2	Astragal	S771BL		PE
1	Gasketing Pair	S773BL		PE
2	ElectroLynx Harness	QC-Cxxx sized for door width		MK
2	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	AQD Series		SU

Notes:
Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 23.0
Doors: 1700A, 2404
Description: Pair - SVR/Lever - Closer - KP

6	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
2	SVR Exit, Classroom	72 NB8713 ETNJ	US32D	SA
2	Perm Core	as req	626	BE
2	Surface Closer	351 UO	EN	SA
2	Armor Plate	K1050 36" 4BE CSKCSK	US32D	RO
2	W/F Stop	406 / 441CU	US26D	RO
2	Astragal	S771BL		PE
1	Gasketing Pair	S773BL		PE

Set: 24.0
Doors: 2211, 2411A
Description: Pair - SVR/Lever - Closer / HO - KP

6	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
2	SVR Exit, Classroom	72 NB8713 ETNJ	US32D	SA
2	Perm Core	as req	626	BE
2	Surface Closer w/ hold open	351 PSH	EN	SA
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Pair	S773BL		PE
1	Mullion Gasketing	5110BL		PE

Set: 25.0
Doors: 0102, 1406A, 1406B
Description: Pair - Storeroom - AFB - Closer/stop

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Automatic Flush Bolt	2842/2942	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Coordinator	2672	US28	RO
2	Mounting Bracket	2601AB or 2601C	US28	RO
2	Surface Closer	351 PS	EN	SA

1	Astragal	S771BL		PE
1	Astragal	3572SP		PE
1	Gasketing Pair	S773BL		PE

Set: 26.0
Description: Not Used - Pair - Storeroom - AFB - Closer - EMHO

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Automatic Flush Bolt	2842/2942	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Coordinator	2672	US28	RO
2	Mounting Bracket	2601AB or 2601C	US28	RO
2	Surface Closer	351 UO	EN	SA
2	Electromagnetic Holder	998M x Voltage	689	RF
1	Astragal	S771BL		PE
1	Astragal	3572SP		PE
1	Gasketing Pair	S773BL		PE

Notes: Doors are magnetically held open and must be tied in to fire control. Upon loss of power or signal from fire control doors will close and latch. Power and wiring is by others.

Set: 27.0
Doors: 1413A, 2219, 2303, 2309, 2413A, 2413B
Description: Pair - Storeroom - AFB - Closer

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Automatic Flush Bolt	2842/2942	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Coordinator	2672	US28	RO
2	Mounting Bracket	2601AB or 2601C	US28	RO
2	Surface Closer	351 UO	EN	SA
2	W/F Stop	406 / 441CU	US26D	RO
1	Astragal	S771BL		PE
1	Astragal	3572SP		PE
1	Gasketing Pair	S773BL		PE

Set: 28.0
Doors: S041, S091A, S092
Description: Pair - Rated SVR/Passage - Closer/stop - KP

6	Hinge, Full Mortise	TA2714	US26D	MK
2	SVR Exit, Passage	12 NB8715 ETNJ	US32D	SA
2	Surface Closer	351 PS	EN	SA
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO

1	Astragal	S771BL		PE
1	Gasketing Pair	S773BL		PE

Set: 29.0
Doors: 1706A
Description: Pair - Classroom - AFB - Closer

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Automatic Flush Bolt	2842/2942	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Classroom Lock	72 8237 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Coordinator	2672	US28	RO
2	Mounting Bracket	2601AB or 2601C	US28	RO
2	Surface Closer	351 UO	EN	SA
2	W/F Stop	406 / 441CU	US26D	RO
1	Astragal	3572SP		PE
1	Gasketing Pair	S773BL		PE

Set: 30.0
Doors: 2308A
Description: Pair - Storeroom - MFB - Closer

6	Hinge, Full Mortise	TA2714	US26D	MK
2	Flush Bolt	555 / 557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surf Overhead Stop	10-X36	630	RF
2	Surface Closer	422 CTB2	EN	SA
1	Astragal	S771BL		PE
2	Silencer - Metal Frame	608		RO

Set: 31.0
Doors: 1623A
Description: Pair - Storeroom - MFB - OH Stop

6	Hinge, Full Mortise	TA2714	US26D	MK
2	Flush Bolt	555 / 557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
2	Surf Overhead Stop	10-X36	630	RF
1	Astragal	S771BL		PE
2	Silencer - Metal Frame	608		RO

Set: 32.0
Doors: 2201A, 2201B, 2202A, 2202B
Description: Pair - SVR/Lever - Closer/Hold Open - KP - Tall

8	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
2	SVR Exit, Classroom	72 NB8713 ETNJ	US32D	SA
2	Perm Core	as req	626	BE
2	Surface Closer w/ hold open	351 PSH	EN	SA
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	W/F Stop	406 / 441CU	US26D	RO
2	Astragal	S771BL		PE
1	Gasketing Pair	S773BL		PE

Notes: Confirm fire rating. Fire rated doors will require EMHO and rated panic devices.

Set: 32.1
Doors: 2412A
Description: Pair - SVR/Lever - Closer/Hold Open - KP - 7'

6	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
2	SVR Exit, Classroom	72 NB8713 ETNJ	US32D	SA
2	Perm Core	as req	626	BE
2	Surface Closer w/ hold open	351 PSH	EN	SA
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	W/F Stop	406 / 441CU	US26D	RO
2	Astragal	S771BL		PE
1	Gasketing Pair	S773BL		PE

Notes: Confirm fire rating. Fire rated doors will require EMHO and rated panic devices.

Set: 33.0
Doors: 1505, 1505A, 1505B
Description: Sgl - SN200/FS Lock - Card Reader - Closer

2	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QCxx	US26D	MK
1	Access Control Mort Lock	72 SN200-82270- LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	AQD Series		SU

Notes:
Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 33.1
Doors: 2110
Description: Sgl - SN200/FS Lock - Card Reader - Closer - Tall

3	Hinge, Full Mortise	TA2714	US26D	MK	
1	Hinge, Full Mortise	TA2714 QCxx	US26D	MK	⚡
1	Access Control Mort Lock	72 SN200-82270- LNNJ	US26D	SA	⚡
1	Perm Core	as req	626	BE	
1	Surface Closer	351 UO	EN	SA	
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO	
1	W/F Stop	406 / 441CU	US26D	RO	
1	Gasketing Sgl	S773BL		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Power Supply	AQD Series		SU	⚡

Notes:
Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 34.0
Doors: 1220
Description: Sgl - SN200/FS Lock - Card Reader - Closer - Wide

2	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK	
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx	US26D	MK	⚡
1	Access Control Mort Lock	72 SN200-82270- LNNJ	US26D	SA	⚡
1	Perm Core	as req	626	BE	
1	Surface Closer	351 UO	EN	SA	
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO	
1	W/F Stop	406 / 441CU	US26D	RO	
1	Gasketing Sgl	S773BL		PE	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Power Supply	AQD Series		SU	⚡

Notes:
Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 35.0
Doors: S011B, S012, S013, S033, S083, S103, S113
Description: Sgl - Rated Rim/SN200/FSafe - Card Reader - Closer

2	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK	
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx	US26D	MK	⚡
1	Rim Exit, SN200 Fail Safe	12 72 SN200-8875 ETNJ	US32D	SA	⚡
1	Perm Core	as req	626	BE	
1	Surface Closer	351 UO	EN	SA	
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO	
1	W/F Stop	406 / 441CU	US26D	RO	
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK	⚡

1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	AQD Series		SU

Notes:
Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 36.0
Doors: 1505C
Description: Pair - SN200 Lock- AFB - Closer

5	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QCxx	US26D	MK
1	Automatic Flush Bolt	2842/2942	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Access Control Mort Lock	72 SN200-82271- LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Coordinator	2672	US28	RO
2	Mounting Bracket	2601AB or 2601C	US28	RO
2	Surface Closer	351 UO	EN	SA
2	W/F Stop	406 / 441CU	US26D	RO
1	Astragal	3572SP		PE
1	Gasketing Pair	S773BL		PE
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK
1	ElectroLynx Harness	QC-C1500P		MK
1	Position Switch	DPS-M-BK		SU
1	Power Supply	AQD series		SU

Set: 37.0
Doors: 2138
Description: Sgl - SN200/FS Lock - Card Reader - Closer

2	Hinge, Full Mortise	TA2714	US26D	MK
1	Hinge, Full Mortise	TA2714 QCxx	US26D	MK
1	Access Control Mort Lock	72 SN200-82270- LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE
1	ElectroLynx Harness	QC-Cxxx sized for door width		MK
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	AQD Series		SU

Notes:
Coordinate voltage, operation and electrical characteristics with all related trades.

Set: 38.0

Doors: 0101A, 0101B, 1048, 1308A, 1403, 1507, 1513, 1622, 1706B, 1707, 2001, 2002, 2136, 2137, 2139, 2204A, 2204B, 2206A, 2206B, 2212A, 2212B, 2301, 2307, 2309A, 2311, 2414, 3002, 3007A, 3008, 3009, 3010, 3011A, 3012
Description: Sgl - Storeroom - Closer - KP- Gasket

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 39.0
Doors: 1312
Description: Sgl - Storeroom - Closer - KP- Gasket - Coated

3	Hinge, Full Mortise	TA2314	US32D	MK
1	Storeroom/Closet Lock	CPC 72 8204 LNNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Notes: **At aluminum frames, gasketing/silencer is by the frame manufacturer

Set: 40.0
Doors: 1704
Description: Sgl - Storeroom - Closer - KP - Gasket - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 41.0
Doors: 1411
Description: Sgl - Storeroom - Closer/stop - KP - Gasket

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing Sgl	S773BL		PE

Set: 42.0
Description: Not Used - Sgl - Office - Closer - KP-Gasket

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Office/Entry Lock	72 8205 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 43.0
Doors: 0100B
Description: Sgl - Rim/Storeroom - Closer/stop

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Rim Exit Device	72 8806 ETNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 PS	EN	SA
1	Gasketing Sgl	S773BL		PE

Set: 44.0
Doors: 2411B, 2412B
Description: Sgl - Rim/Lever - Closer / HO - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Rim Exit, Classroom	72 8813 ETNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer w/ hold open	351 PSH	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 45.0
Description: Not Used - Sgl - Rated Rim/Lever - Closer - EMHO - KP

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Rim Exit, Classroom	(12) 72 8813 ETNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Electromagnetic Holder	998M x Voltage	689	RF
1	Gasketing Sgl	S773BL		PE

Notes: Doors are magnetically held open and must be tied in to fire control. Upon loss of power or signal from fire control doors will close and latch. Power and wiring is by others.

Set: 46.0
Doors: S6.52
Description: Sgl - Rated Rim/Lever - Closer - Gasket - KP

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Rim Exit, Classroom	(12) 72 8813 ETNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 47.0
Doors: S032, S082, S101, S102, S114
Description: Sgl - Rated Rim/Passage - Closer - KP

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Rim Exit, Passasge	12 8815 ETNJ	US32D	SA
1	Surface Closer	422 CTB2	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 47.1
Doors: 3400C
Description: Sgl - Rim/Passage - Closer - KP

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Rim Exit Device, Passage	8815 ETNJ	US32D	SA
1	Surface Closer	422 CTB2	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 48.0
Doors: 1208
Description: Sgl - Passage - Closer - KP - Gasket - Wide - Coated

3	Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1	Passage Latch	CPC 8215 LNNJ	US32D	SA
1	Surface Closer	422 CTB2	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 49.0
Doors: 2209
Description: Sgl - Passage - Closer - Gasket KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNNJ	US26D	SA
1	Surface Closer	422 CTB2	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 50.0
Doors: 1202, 2409
Description: Sgl - Storeroom - Closer - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 51.0
Doors: 1206, 1404, 1617, 1618, 1632, 1664, 2140
Description: Sgl - Storeroom - Closer - KP - Soiled/Clean

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Armor Plate	K1050 36" 4BE CSKCSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 52.0
Doors: 2312, 2313
Description: Sgl - Storeroom - Closer - KP - Soiled/Clean - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Armor Plate	K1050 36" 4BE CSKCSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 53.0
Doors: 2133
Description: Sgl - Storeroom - No Closer - KP - Soiled/Clean

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA

1	Perm Core	as req	626	BE
1	Armor Plate	K1050 36" 4BE CSKCSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 54.0
Doors: 1224B
Description: Sgl - Storeroom - Closer - KP- Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 55.0
Doors: 1708, 3005
Description: Sgl - Storeroom - Closer/stop - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
3	Silencer - Metal Frame	608		RO

Set: 56.0
Description: Not Used - Sgl - Storeroom - Closer/stop - Gasket Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 PS	EN	SA
1	Gasketing Sgl	S773BL		PE

Set: 57.0
Doors: 2103A
Description: Sgl - Storage

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	72 8204 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 58.0
Doors: 1102, 1219A, 1605

Description: Sgl - Office - Closer - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Office/Entry Lock	72 8205 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 59.0
Doors: 1510A
Description: Sgl - Office - Closer - KP - Gasket

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Office/Entry Lock	72 8205 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 60.0
Doors: 0106, 1104, 1105, 1106, 1107, 1108, 1409, 1410, 1510B, 1511, 1514, 1515, 1516, 1606, 1607, 2104, 2106, 2107, 2108, 2121, 2126, 2132, 2145, 2150, 2158, 2302
Description: Sgl - Office

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Office/Entry Lock	72 8205 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	W/F Stop	406 / 441CU	US26D	RO
1	Silencer - Metal Frame	608		RO

Set: 60.1
Doors: 1204
Description: Sgl - Office - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Office/Entry Lock	72 8205 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	W/F Stop	406 / 441CU	US26D	RO
1	Silencer - Metal Frame	608		RO

Set: 61.0
Description: Not Used - Sgl - Office - Coated

3	Hinge, Full Mortise	TA2314	US32D	MK
1	Office/Entry Lock	CPC 72 8205 LNNJ	US32D	SA
1	Perm Core	as req	626	BE

1	W/F Stop	406 / 441CU	US26D	RO
1	Silencer - Metal Frame	608		RO

Set: 62.0
Doors: 1407, 1408B, 3200A, 3200B, 3400A, 3400B
Description: Sgl - Rim/Lever (CR)- Closer - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Rim Exit, Classroom	72 8813 ETNJ	US32D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 63.0
Doors: 1508B, 1620B, 1663, 1702, 2103, 2159
Description: Sgl - Classroom - Closer - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	72 8237 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 64.0
Doors: 1100B, 1517B, 1604, 1660E
Description: Sgl - Classroom - Closer - KP - Gasket

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	72 8237 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 65.0
Doors: 1620A, 2304
Description: Sgl - Classroom - Closer - KP - Gasket - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Classroom Lock	72 8237 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing Sgl	S773BL		PE

Set: 66.0
Doors: 2203A, 2203B, 2205A, 2205B
Description: Sgl - Classroom - Closer / Hold Open

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	72 8237 LNNJ	US26D	SA
1	Perm Core	as req	626	BE
1	Surface Closer	351 H	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 67.0
Doors: 1660A
Description: Sgl - Passage - Closer - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNNJ	US26D	SA
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 68.0
Doors: 1207, 1616, 1631, 1667, 2141
Description: Sgl - Passage

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 69.0
Doors: 1504B
Description: Sgl - Passage - Closer - Gasket KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNNJ	US26D	SA
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 69.1
Doors: 1504A
Description: Pair - Passage - AFB - Closer

6	Hinge, Full Mortise	TA2714	US26D	MK

1	Automatic Flush Bolt	2842/2942	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Passage Latch	8215 LNNJ	US26D	SA
1	Coordinator	2672	US28	RO
2	Mounting Bracket	2601AB or 2601C	US28	RO
2	Surface Closer	351 UO	EN	SA
2	W/F Stop	406 / 441CU	US26D	RO
1	Astragal	S771BL		PE
1	Astragal	3572SP		PE
1	Gasketing Pair	S773BL		PE

Set: 70.0
Description: Not Used - Sgl - Passage - Closer/stop - Gasket KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	8215 LNNJ	US26D	SA
1	Surface Closer	351 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing Sgl	S773BL		PE

Set: 71.0
Doors: 1212, 1213, 1215, 1216, 1217, 1225, 1655
Description: Sgl - Passage - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Passage Latch	8215 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 71.1
Doors: 2113
Description: Sgl - Passage - Wide - Hinge Cover

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Finger Protection	FSR6000C82 82	C	PE
1	Passage Latch	8215 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 72.0
Doors: 1656, 1657, 1662, 1662A
Description: Sgl - Passage - Lead Lined

1	Pivot Set	L147-20	626	RF
1	Intermediate Pivot	ML19-20	626	RF
1	Passage Latch - Lead Lined	74 8215 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 73.0
Doors: 2116, 2117, 2118, 2122, 2123, 2124, 2129, 2130, 2131, 2142, 2143, 2144, 2147, 2148, 2149, 2154, 2155, 2156
Description: Sgl - Passage - OH Stop - Hinge Cover

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Finger Protection	FSR6000C82 82	C	PE
1	Passage Latch	8215 LNNJ	US26D	SA
1	Surf Overhead Stop	9-X36	630	RF
3	Silencer - Metal Frame	608		RO

Set: 74.0
Doors: 2112
Description: Sgl - Passage - OH Stop - Wide - Hinge Cover

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Finger Protection	FSR6000C82 82	C	PE
1	Passage Latch	8215 LNNJ	US26D	SA
1	Surf Overhead Stop	9-X36	630	RF
3	Silencer - Metal Frame	608		RO

Set: 75.0
Doors: 0107, 1103, 1512, 1518, 1519, 1621, 1661, 1701, 2102, 2109, 2120, 2127, 2152, 2153, 2210, 2310
Description: Sgl - Privacy/IND - Closer - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 76.0
Doors: 1636
Description: Sgl - Privacy/IND - Closer - KP - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	Surface Closer	351 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 77.0
Doors: 1203, 1412, 2135
Description: Sgl - Privacy/IND - Closer/stop - KP

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA

1	Surface Closer	351 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing Sgl	S773BL		PE

Set: 78.0
Doors: 2134
Description: Sgl - Privacy/IND - Closer/stop - KP - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	Surface Closer	351 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing Sgl	S773BL		PE

Set: 79.0
Doors: 1218, 1319, 1613
Description: Sgl - Privacy/IND

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 79.1
Doors: 1205, 1211, 1654B
Description: Sgl - Privacy/IND - Wide

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE

Set: 80.0
Doors: 1317, 1318
Description: Sgl - Privacy/IND - Coat Hook

4	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
1	Gasketing Sgl	S773BL		PE
1	Coat Hook	RM802	US32D	RO

Set: 81.0
Doors: 1003, 1004, 1602, 1603
Description: Sgl - Rescue - Privacy/IND

1	Pivot	EP-5J	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO

2	Edge Seal	369CP		PE
1	Combination Stop/Strike	CSS-9x5-3/4 CH	US26D	MK

Set: 82.0
Doors: 1209, 1210, 1322, 1324, 1325, 1611, 1612, 1633, 1634
Description: Sgl - Rescue - Privacy/IND - Coat Hook

1	Pivot	EP-5J	US26D	MK
1	Privacy Lock	V20 8265 LNNJ	US26D	SA
1	W/F Stop	406 / 441CU	US26D	RO
1	Edge Seal	369CP		PE
1	Combination Stop/Strike	CSS-9x5-3/4 CH	US26D	MK
2	Coat Hook	RM802	US32D	RO

Set: 83.0
Doors: 1316A, 1316B, 2207, 2208, 2407, 2408
Description: Sgl - Push/Pull - Closer - KP

3	Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1	Push Plate	70F	US32D	RO
1	Straight Door Pull	RM7210-36 Mtg-Type 12HD	US32D	RO
1	Surface Closer	422 CTB2	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	W/F Stop	406 / 441CU	US26D	RO
3	Silencer - Metal Frame	608		RO

Set: 84.0
Doors: 0102A, 0104A, 0104B, 0104C, 0105A
Description: Cyl Only

2	Cylinder	72-as req	626	BE
2	Perm Core	as req	626	BE
1	Balance of hardware by the door provider			00

Set: 85.0
Doors: 1000, 1001, 1201, 1305A, 1329, 1330, 1610, 1623, 1630, 1653, 1714B, 1715, 2100B, 4000D, E042, W1000
Description: All Hardware by Dr provider

1	All Hardware by door manufacturer.			00

Set: 86.0
Doors: 1001A, 1001B, 1100A, 1200, 1219B, 1301C, 1517A, 1600, 2100A, 2405
Description: Fire Rated Aluminum

1	Cylinder	72-as req	626	BE
1	Perm Core	as req	626	BE
1	Balance of hardware by the door provider			00

Set: 87.0
Doors: 1301B, 1320, 1323
Description: Double Acting by Dr provider

1	All Hardware by door manufacturer.		00

Set: 88.0
Doors: 2308B, S042
Description: Not Found

1	Opening	Not found on the door schedule	OT

END OF SECTION 087100

SECTION 08 71 13 AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Exterior and interior, automatic door operators, low energy, with visible header mounting

B. Automatic door operators shall be configured for doors as follows:
   1. Simultaneous pairs, same swing
   2. Single doors.

1.2 RELATED REQUIREMENTS

A. Section 01 30 00 – Administrative Requirements: Requirements for submittal procedures, project meetings, progress schedules, and documentation, reports, and coordination.

B. Section 01 60 00 – Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

C. Section 08 10 00 - Doors and Frames: Entrances furnished and installed separately.

D. Section 08 40 00 - Entrances, Storefronts and Curtain Walls: Entrances furnished and installed separately.

E. Section 08 71 00 - Door Hardware: Hardware to the extent not specified in this Section.

F. Division 26 00 00 – Electrical: Electrical connections provided separately including conduit and wiring for power to, and control of, automatic door operators.

G. Division 28 00 00 - Electronic Safety and Security: Systems not specified in this section.

1.3 DEFINITIONS

A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.

B. Knowing act: Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.

1.4 REFERENCE STANDARDS

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. American Architectural Manufacturers Association (AAMA):
   1. AAMA 607.1 - Clear Anodic Finishes for Architectural Aluminum.
   2. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.

C. American Association of Automatic Door Manufacturers (AAADM).

D. American National Standards Institute (ANSI)/Builders' Hardware Manufacturers Association (BHMA):
   1. ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
   2. ANSI/BHMA A156.19: Standard for Power Assist and Low Energy Power Operated Doors.

E. American Society for Testing and Materials (ASTM):
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

F. Builders Hardware Manufacturers Association (BHMA):
   1. A156.19 Power Assist & Low Energy Power Operated Doors.

G. International Code Council (ICC):
   1. IBC: International Building Code.

H. International Standards Organization (ISO):
   1. ISO 9001 - Standard for Manufacturing Quality Management Systems.
   2. ISO 14025 – Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures.
   3. ISO14040 – Environmental Management -- Life Cycle Assessment -- Principles and Framework.
   4. ISO 14044 – Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines.
   5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works -- Core Rules For Environmental Product Declarations Of Construction Products And Services.

I. National Association of Architectural Metal Manufacturers (NAAMM):
   1. Metal Finishes Manual for Architectural and Metal Products.

J. National Fire Protection Association (NFPA):
   1. NFPA 101 – Life Safety Code.
   2. NFPA 70 – National Electric Code.

K. Underwriters Laboratories (UL):
   1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
   2. UL 10C – Positive Pressure Fire Tests of Door Assemblies.

L. United Nations Central Product Classification (UNCPC):
   1. UNCPC 4212 - Product Category Rules for Preparing an Environmental Product Declaration for Power-Operated Pedestrian Doors and Revolving Doors.

1.5 COORDINATION

A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.

B. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to, power supplies, remote activation devices, electric door latching hardware, and security access control system. Refer to Division 28 00 00 - Electronic Safety and Security for systems not provided under this section.

C. System Integration: Integrate automatic door operators with other systems as required for a complete working installation.

1. Provide electrical interface control capability for activation of automatic door operators by security access system on doors with electric locking.
2. Where indicated to install both knowing act and secure activation system, automatic door operators shall be configured to operate; by knowing act, after verification from secure activation system, when secured; by knowing act when not secured.
3. Where required for proper operation, provide a time delay relay to signal automatic door operator to activate only after electric lock system is released.
4. Provide electrical interface with door latching hardware to enable exterior knowing act activation device only when latching hardware is dogged.
5. Provide electrical interface to deactivate automatic door operators on activation of fire alarm system.

1.6 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Section 01 30 00 – Administrative Requirements: Submittal procedures.

B. Action Submittals”
1. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work. Indicate wiring for electrical supply.
2. Color Samples for selection of factory-applied color finishes.

C. Information Submittals: Based on evaluation performed by a qualified agency, for automatic entrance door assemblies.
1. Environmental Product Declaration.
2. Evaluation Report for compliance with IBC.

D. Closeout Submittals: Provide the following with project close-out documents.
1. Owner’s Manual.
2. Warranties.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain automatic door operators through one source from a single manufacturer.

B. Qualifications
1. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained in the installation and maintenance of units required for this Project.
2. Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility compliant with ISO 9001.
3. Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.

C. Certifications:
1. Automatic door operators shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:
   a. ANSI/BHMA A156.10 and A156.19.
   b. BHMA Certified Products Directory, Listed.
   c. IBC.
   d. NFPA 101.
      UL 325 Listed.
   e. UL 10C Listed.
2. Environmental Product Declaration (EPD): EPD for automatic door operators shall be certified by the manufacturer to comply with the following:

a. Prepared under Product Category Rule (PCR) UNCPC 4212.
b. Conform to ISO standards 14025, 14040, 14044, 21930.
c. Life Cycle Assessment Basis: Cradle to Gate, minimum.

1.8 FIELD CONDITIONS

A. Field Measurements: General Contractor shall verify openings to receive automatic door operators by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight, and secure; substrates to be of proper dimension and material.

C. Other trades: General Contractor Advise of any inadequate conditions or equipment.

1.9 WARRANTY

A. Automatic door operators shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.

B. During the warranty period the Owner shall engage a factory-trained technician to perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the Owner.

C. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

PART 2 - PRODUCTS

2.1 AUTOMATIC DOOR OPERATORS

A. Manufacturer: Stanley Access Technologies (www.stanleyaccess.com); M-Force™ Series automatic door operator.
1. Contact: Stanley Access Technologies, Russell Elkins; Phone: 985-624-5278, Fax: 985-626-9515, Email: Russell.Elkins@allegion.com

B. Substitutions: Not permitted.

C. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of swinging doors equipped with automatic door operators and are based on the specific system indicated. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE / DESIGN CRITERIA

A. General: Provide automatic door operators capable of withstanding loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Operating Range: Minus 30 deg F (Minus 34 deg C) to 130 deg F (54 deg C).

C. Opening-Force Requirements for Egress Doors: In the event power failure to the operator, swinging automatic entrance doors shall open with a manual force, not to exceed 30 lbf (133 N) to set door in motion, and not more than 15 lbf to fully open the door. Forces shall be applied at

1” (25 mm) from the latch edge of the door.

2.3 REGULATORY REQUIRMENTS

A. Power Operated Door Standard: ANSI/BHMA A156.19.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for swinging automatic entrance doors serving as a required means of egress.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Headers: 6063-T6.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Sheet and Plate: ASTM B 209.

2.5 COMPONENTS

A. Header Case: Header case shall not exceed 6” (152 mm) square in section and shall be fabricated from extruded aluminum with structurally integrated end caps, designed to conceal door operators and controls. The operator shall be sealed against dust, dirt, and corrosion within the header case. Access to the operator and electronic control box shall be provided by a full-length removable cover, edge rabbeted to the header to ensure a flush fit. Removable cover shall be secured to prevent unauthorized access.

B. Door Arms: A combination of door arms and linkage shall provide positive control of door through entire swing; units shall permit use of butt hung, center pivot, and offset pivot-hung doors.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.

D. Signage: Provide signage in accordance with ANSI/BHMA A156.19.

2.6 SWINGING DOOR OPERATORS

A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Electromechanical Operators: Self-contained unit powered by a minimum 3/16 horsepower, permanent-magnet DC motor; through a high torque reduction gear system.
1. Operation: Power opening and spring closing.
2. Operator Type: Low energy; readily convertible to full energy; no tools required to change type.
3. Handing: Non-handed; no tools required to change handing.
4. Capacity: Rated for door panels weighing up to 700 lb (318 kg).
5. Mounting: Visible.
6. Features:
    a. Adjustable opening and closing speeds.
    b. Adjustable opening and closing force.

c. Adjustable back-check.
d. Adjustable hold-open time between 0 and 30 seconds.
e. Reverse on obstruction.
f. Force compensation and closed loop speed control with active braking and acceleration.
g. Power Close.
h. Slam Protection.
i. Power Assist.
j. Lock Release.
k. Stall Sensor Ignore.
l. Electronic Coordination.
m. Optional Switch to open/Switch to close operation.
n. Optional push to activate operation.
o. Fire alarm interface, configurable to safely open or close doors on signal from fire alarm system.

C. Field Adjustable Spring Closing Operation: The operator shall close the door by spring energy employing the motor, as a dynamic brake to provide closing speed control. The closing spring shall be a helical compression spring, adjustable for positive closing action. The spring shall be adjustable, without removing the operator from the header, to accommodate a wide range of field conditions.

D. Independent Adjustable Closing and Latching Speed Control: The operator shall employ a rheostat module to allow for independent field adjustment of closing and latching speeds using the motor as a dynamic brake.

E. Field Adjustable Open Stop: The operator shall provide a field adjustable open stop to accommodate opening angles from 80 to 135 degrees without the need for additional components.

F. Consistent Cycle: The operator shall deliver an even, consistent open manual push force across the entire transition from door fully closed to door fully open. Additionally, the force shall be field adjustable to accommodate a wide range of on-site conditions.

G. Quiet Performance: The operator shall be designed to output audible noise ratios less than or equal to 50dba.

H. Manual Use: The operator shall function as a manual door closer in the direction of swing with or without electrical power. The operator shall deliver an even, consistent open force across the entire transition from door fully closed to door fully open.

I. Electrical service to door operators shall be provided under Division 26 Electrical. Minimum service to be 120 VAC, 5 amps.

2.7 ELECTRICAL CONTROLS

A. Electrical Control System: Electrical control system shall include a microprocessor controller and a high-resolution position encoder. The encoder shall monitor revolutions of the operator shaft and send signals to microprocessor controller to define door position and speed.
1. The high-resolution encoder shall have a resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
2. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.

B. Performance Data: The microprocessor shall collect, and store performance data as follows:
1. Counter: A non-resettable counter to track operating cycles.

2. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
3. LED Display: Display presenting the current operating state of the controller.

C. Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:
1. Automatic Reset Upon Power Up.
2. Main Fuse Protection.
3. Electronic Surge Protection.
4. Internal Power Supply Protection.
5. Resetable sensor supply fuse protection.
6. Motor Protection, over-current protection.

D. Power Close: When enabled, engages the operator to close a door that does not close completely at the end of a cycle.

E. Force Compensation: Utilizing the closed loop speed control, the operator shall maintain constant opening and closing speeds when subjected to excessive outside forces, such as positive or negative stack pressures.

F. Slam Protection: The operators speed control system prevents door from slamming at the full open or full closed position.

G. Power Assist: Operator mode that lowers opening forces when the door is used manually. Power assist is active only while pushing or pulling the door. The door will close when an opening force is no longer applied.

H. Lock Release: On doors with electric locking, operator shall include a closing function to release tension on a latch mechanism prior to opening the door.

I. Stall Sensor Ignore: Adjustable setting to disable swing side safety sensors at a specific angle.

J. Electronic Coordination: On pairs of doors, allows independent timing of opening and closing of each leaf as required for astragal coordination.

K. Soft Start/Stop: A “soft-start” “soft-stop” motor driving circuit shall be provided for smooth normal opening and recycling.

L. Obstruction Recycle: Provide system to recycle the swinging panels when an obstruction is encountered during the closing cycle.

M. Programmable Controller: Microprocessor controller shall be field programmable.
1. The following parameters may be adjusted:
   a. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
   b. Adjustable and variable features specified.
2. Manual programming shall be available through local interface which has a two-digit display with a selection control including three push buttons.

N. Auxiliary Door Position Switch: An auxiliary cam actuated door position switch shall be provided which can be used to signal other devises or systems of the doors position. The switch shall include both normally open and normally closed contacts.

O. Emergency Breakout Switch: A cam actuated emergency breakout switch shall be provided to disconnect power to the motor when an in-swinging door is manually pushed in the emergency

out direction. The operator will then automatically reset, and power will be resumed.

P. Control Switch: Automatic door operators shall be equipped with a three-position function switch to control the operation of the door. Control switch shall provide three modes of operation, Automatic, Off, and Hold-Open.

Q. Power Switch: Automatic door operators shall be equipped with a two position On/Off switch to control power to the door.

2.8 ACTIVATION DEVICES

A. Secure Activation: Secure activation device provided by others as specified in Division 28 00 00 - Electronic Safety and Security.

B. Push Plates: Provide 4 1/2 inch (114 mm) square push plates with UL recognized SPDT switch. Face plates and mounting studs shall be stainless steel. Face plates shall be engraved with the international symbol for accessibility and “Push To Open”.
1. Push plates shall be wall mounted in single or double gang electrical boxes and hardwired to door operator controls.
2. Push plates shall be similar to or better than BEA 10PBS451.

C. Touchless Activation Switch: Provide touchless activation switches for primary activation of sliding automatic entrances from interior. Face plates shall be engraved with waving hand logo and “Wave To Open” text.
1. Switches shall be recess wall style, double or single gang and hardwired to door operator controls.
2. Units shall incorporate microwave frequency to detect all motion in the detection zone. Detection zone shall be adjustable from 4 inch to 24 inch (51 mm to 610 mm).
3. LED indicator for activation confirmation.
4. Relay shall be rated at 1 A at 60 VDC.
5. Relay hold time adjustable from 0.5 to 30 sec.
6. IP55 rated enclosure.
7. Touchless activation switches shall be similar to or better than BEA, MS41-D.

2.9 ALUMINUM FINISHES

A. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.

B. Class II, Clear Anodic Finish**:** AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
1. AAMA 607.1
2. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of swinging automatic entrance doors. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Mounting: Install automatic door operators/headers plumb and true in alignment with established lines and grades. Anchor securely in place.
   1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
   2. Set headers, arms and linkages level and true to location with anchorage for permanent support.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 00 00 – Electrical.

3.3 FIELD QUALITY CONTROL

A. Testing Services: Factory Trained Installer shall test and inspect each swinging automatic entrance door to determine compliance of installed systems with applicable ANSI standards.

3.4 REPAIR

A. Repair damaged finish to match original finish.

3.5 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in specified ANSI/BHMA operating standard by AAADM Certified Technician.

3.6 CLEANING

A. Clean surfaces promptly after installation. Remove excess sealant compounds, dirt, and other substances.

END OF SECTION 08 71 13

SECTION 08 80 00 – GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.

B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

C. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.

D. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

E. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

F. ASTM C1036 - Standard Specification for Flat Glass; 2011.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

I. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.

K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.

L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

M. GANA (GM) - GANA Glazing Manual; 2009.

N. GANA (SM) - GANA Sealant Manual; 2008.

O. ICC (IBC) - International Building Code; 2015.

P. IGMA TB-3001 - Guidelines for Sloped Glazing; 2001.

Q. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).

R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.

S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.

T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

B. Coordinate with installation of other components that comprise the glazing systems.

1.5 SUBMITTALS

A. A. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types:
   1. Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
   2. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of glass units, showing coloration and design for Architect’s review and approval.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Shop drawings: Indicate glass types, dimensions, edge conditions, installation methods, wind load support details.

H. Certificates of compliance for safety glazing

I. Manufacturer test reports confirming compliance with ASTM and energy requirements.

J. Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain glass and fabricated glass products through one source from a single manufacturer for each glass type.

B. Perform Work in accordance with GANA (GM), GANA (SM), and IGMA TM-3000 for glazing installation methods.

C. Fabricator Qualifications: Company specializing in work of this section with minimum ten years of documented experience.

D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

E. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.

1.7 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements, for additional mock-up requirements.

B. Provide on-site glazing mock-up with the specified glazing components for exterior insulated laminated glazing variations.

C. Mock-ups may not remain as part of the Work and will be stand-alone assemblies in conjunction with aluminum glazing systems.

1.8 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a five (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

C. Low-e Coating: Provide a ten (10) year warranty to include coverage for deterioration of low-e coating and replacement of same.

D. Lamination: Provide a (5) year manufacturer warranty.

E. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: [**Five** years from date of Substantial Completion.

F Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

Design glass and glazing systems to resist local wind load per ASCE 7, with minimum design pressures for Houma, Louisiana (Risk Category II) based on a basic wind speed of 150 mph, Exposure C, wind borne debris region. Comply with IBC 2021 and applicable local jurisdiction amendments.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2006 International Building Code by a qualified professional engineer, using the following design criteria:**.**

C. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
3. Glass thicknesses listed are minimum.

D. Differential Shading:

Design glass units to withstand thermal stresses resulting from **non-uniform solar exposure** (e.g., partial shading from overhangs, fins, or frit) to avoid breakage or seal failure due to **thermal gradients** within a single lite.

E. Thermal Movements:

Design and detail framing systems and glazing components to accommodate thermal movements from ambient and surface temperature fluctuations.

1.Temperature Range:

Ambient Air Temperature Change: ±120°F (±49°C)

Surface (Material) Temperature Change: ±180°F (±82°C)

F. Thermal Resistance and Visible Light Transmittance of Glazing Assemblies:

Comply with NFRC 100 (U-factor), NFRC 200 (Solar Heat Gain Coefficient), and NFRC 300 (Visible Transmittance). Refer to “Insulating-Laminated Glass Types” article for specific performance values.

G. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.

1. In conjunction with vapor retarder and joint sealer materials described in other sections.
2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.

H. Thermal and Optical Performance: Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
3. Solar Optical Properties: Comply with NFRC 300 test method.

I. Provide safety glazing where required by code, including indoors, sidelites, glazing within 18 inches of the floor, and locations subject to human impact.

J. Comply with ASTM E1300 for minimum glass thickness and support conditions.

K Float Glass: Provide ultra-clear, low-iron float glass.

1. Annealed Glass: ASTM C1036, Type I – Transparent Flat Glass, Class 1 – Clear, Quality-Q3.

2. Heat-Strengthened Glass: ASTM C1048, Kind HS; minimum surface compression of 3,500 psi.

L. Fully Tempered Glass:: Provide ultra-clear, low-iron tempered glass.

1. ASTM C1048, Kind FT; minimum surface compression of 10,000 psi.

2. Complies with ANSI Z97.1 and CPSC 16 CFR 1201 (Category II) for safety glazing.

3. Permanently labeled with manufacturer's safety glazing identification.

4. Provide where required by code, where glazing is subject to human impact, or where thermal stress or wind load conditions exceed safe limits for annealed or heat-strengthened glass.

M. Laminated Glass: Provide ultra-clear, low-iron tempered glass.

1. Conform to ASTM C1172 – Laminated Architectural Flat Glass.

2. Laminated Safety Glass: Two or more plies of float glass laminated with clear polyvinyl butyral (PVB) interlayer; complies with ANSI Z97.1 and CPSC 16 CFR 1201 (Category II).

3. Provide where indicated or required for impact resistance, acoustics, or enhanced security.

2.3 INSULATING – LAMINATED LARGE MISSILE IMPACT GLASS ASSEMBLY UNITS

A Basis-of-Design Manufacturer: Subject to compliance with requirements, provide Viracon, assembly as described, or a comparable product by one of the following:

1. Trulite
2. Viracon
3. Oldcastle.

4. Guardian.
5. PPG

GIF-1

Interior: 1" overall, privacy/diffusion, STC properties

TYPE – Insulating Satin Vision Unit

Glass:

a. Clear and satin etched insulating glass unit..
b. Durability: ASTM E2190 compliant.
c. Safety: Both lites tempered.
d. Spacer: Aluminum, black or bronze.
e. Seal: Dual silicone system.

Make-up: 1/4" Clear Tempered (#2 surface); 1/2" Mill Spacer; 1/4" Satin Tempered (#3 surface, etched).

Performance requirements:

VLT ~65–70%,

U-Factor ~0.47,

SHGC ~0.65,

GT-2,

Exterior: Hurricane/impact resistant when glazed in tested system.

TYPE: Glass: Vitro Solarban 70XL Solexia with clear lite, fabricated by Trulite or approved equal, (Viracon equivalent).

Durability: Certified per ASTM E2190 for insulating glass durability.

Coated Glass: Comply with ASTM C1376 for sputter-coated low-E on flat glass.

Safety: Provide tempered / heat-strengthened glass, laminated with SentryGlas Plus interlayer; tested for impact resistance per code and compatible aluminum systems.

Metal Edge Spacers: Aluminum mill finish, bent/soldered corners.

Spacer Color: Black or dark bronze (architect approval).

Edge Seal: Dual-sealed silicone system around perimeter.

Color: Solexia tint (green solar control glass).

Gas Fill: Dry air purge, hermetically sealed.

Make-up: 1/4" Vitro Solarban 70XL Solexia, tempered (#2 surface coating); 1/2" Mill spacer (black or bronze); 1/4" Clear Heat Strengthened; 0.90" SentryGlas Plus (SGP) laminated interlayer.

Performance requirements:

VLT ~50–55%,

U-Factor ~0.28,

SHGC ~0.27,

Reflectance ~12–13%,

GT-1:

Exterior: Hurricane/impact resistant when glazed in tested system.

TYPE: Double Glazed Clear Solar Control Laminated Insulating Glass Unit [Solarban® 70 * 6mm (2) | Air 1/2" (12.7mm) | 6mmClear_090PVB_6mmClear]

Conformance: ASTM E 2190

Outdoor Lite: Clear/Acuity™ float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.

b. Glass Thickness: 6mm (1/4")

c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.

d. Coating: Solarban® 70 on Surface # 2

e. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**], [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Interspace Content: Air 1/2" (12.7mm)

Indoor Lite: Laminate

a. Conformance: ASTM C1172 and complying with testing requirements

Outboard Lite: Laminate, Clear float glass as manufactured by Vitro Architectural Glass .

a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3

b. Thickness: 6mm (1/4")

c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC

16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Interlayer:

a. Type: PVB

b. Thickness: 0.090" (2.29 mm)

c. Color: Clear

Laminate Inboard Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3

b. Thickness: 6mm (1/4")

c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**]**

[Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Performance requirements:

a. Visible Light Transmittance: 62 percent minimum.

b. Winter Nighttime U-Factor: 0.28 (Btu/hr*ft^2*°F) maximum.

c. Summer daytime U-Factor: 0.26 (Btu/hr*ft^2*°F) maximum.

d. Shading Coefficient: 0.31 maximum.

e. Solar Heat Gain Coefficient: 0.27 maximum.

f. Outdoor Visible Light Reflectance: 13 percent maximum.

GFT-4

Exterior, Hurricane/impact resistant when glazed in tested system, translucent, satin arctic snow

TYPE: INSULATING-GLASS UNIT(S) Double Glazed Tinted Solar Control Laminated Insulating Glass Unit [Solarban® 70 on Solexia® 6mm (2) | Air 1/2" (12.7mm) | 6mmClear_090White2165PVB_6mmClear]

Conformance: ASTM E 2190

Outdoor Lite: Solexia® Tinted float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 2, Quality q3.

b. Glass Thickness: 6mm (1/4")

c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.

d. Coating: Solarban® 70 on Surface # 2

e. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**], [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Interspace Content: Air 1/2" (12.7mm)

Indoor Lite: Laminate

a. Conformance: ASTM C1172 and complying with testing requirements

Laminate Outboard Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3

b. Thickness: 6mm (1/4")

c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**]**

[Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Interlayer:

a. Type: PVB

b. Thickness: 0.090" (2.29 mm)

c. Color: White

Laminate Inboard Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3

b. Thickness: 6mm (1/4")

c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**], [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Performance requirements:

a. Visible Light Transmittance: 40 percent minimum.

b. Winter Nighttime U-Factor: 0.28 (Btu/hr*ft^2*°F) maximum.

c. Summer daytime U-Factor: 0.26 (Btu/hr*ft^2*°F) maximum.

d. Shading Coefficient: 0.28 maximum.

e. Solar Heat Gain Coefficient: 0.25 maximum.

f. Outdoor Visible Light Reflectance: 11 percent maximum.

GFT-5

Exterior, Hurricane/impact resistant when glazed in tested system, translucent, satin arctic snow

TYPE: INSULATING-GLASS UNIT(S) Double Glazed Tinted Solar Control Laminated Insulating Glass Unit [Solarban® 70 on Solexia® 6mm (2) | Air 1/2" (12.7mm) | 6mmClear_090White2165PVB_6mmClear]

Conformance: ASTM E 2190

Outdoor Lite: Solexia® Tinted float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 2, Quality q3.

b. Glass Thickness: 6mm (1/4")

c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.

d. Coating: Solarban® 70 on Surface # 2

*e. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**]***

[**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Interspace Content: Air 1/2" (12.7mm)

Indoor Lite: Laminate

b. Conformance: ASTM C1172 and complying with testing requirements

Laminate Outboard Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3

b. Thickness: 6mm (1/4")

c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**]**

[Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Interlayer:

a. Type: PVB

b. Thickness: 0.090" (2.29 mm)

c. Color: White

Laminate Inboard Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3

b. Thickness: 6mm (1/4")

c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**]**

[Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Performance Requirements:

a. Visible Light Transmittance: 40 percent minimum.

b. Winter Nighttime U-Factor: 0.28 (Btu/hr*ft^2*°F) maximum.

c. Summer daytime U-Factor: 0.26 (Btu/hr*ft^2*°F) maximum.

d. Shading Coefficient: 0.28 maximum.

e. Solar Heat Gain Coefficient: 0.25 maximum.

f. Outdoor Visible Light Reflectance: 11 percent maximum.

GFT-4B

Interior, spandrel, non-impact

TYPE: Double Glazed Tinted Spandrel Insulating Glass Unit [Solexia® 6mm | Air 1/2" (12.7mm) 100% Etch frit (4) on 6mm Clear]

Conformance: ASTM E 2190, [ASTM C 1048, Condition B, Type I, Quality-Q3 and GANA 'Engineering Standards Manual' GANA 66-9-20 Specification for Heat-Strengthened or Fully Tempered Ceramic Enameled Spandrel Glass for Use in Building Window/Curtain Walls and

Other Architectural Applications] or [Float glass complying with ASTM C 1048, GANA ‘Engineering Standards Manual’ GANA 89-1-6 Specification for Environmental Durability of Fully Tempered or Heat-Strengthened Spandrel Glass with Applied Opacifier and other requirements specified, with manufacturer’s standard opacifier material on coated second surface of lites]

Outdoor Lite: Solexia® 6mm Tinted float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 2, Quality q3.
b. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]***Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.*
c. Glass Thickness: 6mm (1/4")

Interspace Content: Air 1/2" (12.7mm)

Indoor Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.

b. Glass Thickness: 6mm (1/4")

c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]***Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.*

Performance Requirements:

a. Visible Light Transmittance: 65 percent minimum.

b. Winter Nighttime U-Factor: 0.47 (Btu/hr*ft^{2}*°F) maximum.

c. Summer daytime U-Factor: 0.50 (Btu/hr*ft^{2}*°F) maximum.

d. Shading Coefficient: 0.57 maximum.

e. Solar Heat Gain Coefficient: 0.49 maximum.

f. Outdoor Visible Light Reflectance: 13 percent maximum.

GT-1B

Interior, spandrel, non-impact, green tint over clear, 1" overall

TYPE: Double Glazed Tinted Insulating Glass Unit [Solexia® 6mm | Air 1/2" (12.7mm) | Clear 6mm]

Conformance: ASTM E 2190

Outdoor Lite: Solexia® 6mm Tinted float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 2, Quality q3.
b. Heat-Treatment: [None] [Heat-strengthened, ASTM C 1048, Kind HS] [Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201]

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

c. Glass Thickness: 6mm (1/4")

Interspace Content: Air 1/2" (12.7mm)

Indoor Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.

b. Heat-Treatment: [None] [Heat-strengthened, ASTM C 1048, Kind HS] [Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201]

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

d. Glass Thickness: 6mm (1/4")

Performance Requirements:

a. Visible Light Transmittance: 69 percent minimum.

b. Winter Nighttime U-Factor: 0.47 (Btu/hr*ft^2*°F) maximum.

c. Summer daytime U-Factor: 0.50 (Btu/hr*ft^2*°F) maximum.

d. Shading Coefficient: 0.57 maximum.

e. Solar Heat Gain Coefficient: 0.50 maximum.

f. Outdoor Visible Light Reflectance: 13 percent maximum.

GI-1

Interior, ¼" monolithic glass

TYPE: Monolithic Clear Glass [Clear 6mm], Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.

b. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

c. Glass Thickness: 6mm (1/4")

Performance requirements:

a. Visible Light Transmittance: 89 percent minimum.

b. Winter Nighttime U-Factor: 1.02 (Btu/hr*ft^2*°F) maximum.

c. Summer daytime U-Factor: 0.92 (Btu/hr*ft^2*°F) maximum.

d. Shading Coefficient: 0.94 maximum.

e. Solar Heat Gain Coefficient: 0.82 maximum.

f. Outdoor Visible Light Reflectance: 8 percent maximum.

GI-1L

Interior, laminated, tempered, baffles, handrails

TYPE: Monolithic Clear Laminated Glass [6mmClear_060PVB_6mmClear]

Conformance: ASTM C1172 and complying with testing requirements

Outboard Lite: Clear float glass as manufactured by Vitro Architectural Glass.

a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3
b. Thickness: 6mm (1/4")
c. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Interlayer:

a. Type: PVB
b. Thickness: 0.060" (1.52 mm)
c. Color: Clear
d. Inboard Lite: Clear float glass as manufactured by Vitro Architectural Glass.
    1. Conformance: ASTM C 1036, Type I, Class 1, Quality q3
    2. Thickness: 6mm (1/4")
    3. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

Performance requirements:

a. Visible Light Transmittance: 86 percent minimum.

b. Winter Nighttime U-Factor: 0.95 (Btu/hr*ft^{2}*°F) maximum.

c. Summer daytime U-Factor: 0.86 (Btu/hr*ft^{2}*°F) maximum.

d. Shading Coefficient: 0.82 maximum.

e. Solar Heat Gain Coefficient: 0.71 maximum.

f. Outdoor Visible Light Reflectance: 8 percent maximum.

GT-1B

Interior, insulated with STC properties

TYPE Double Glazed Clear Insulating Glass Unit [Clear 6mm | Air 1/2" (12.7mm) | Clear 6mm]

Conformance: ASTM E 2190

Outdoor Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.

b. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code

c. Glass Thickness: 6mm (1/4")

Interspace Content: Air 1/2" (12.7mm)

Indoor Lite: Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.

b. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code.

c. Glass Thickness: 6mm (1/4")

Performance requirements:

a. Visible Light Transmittance: 79 percent minimum.

b. Winter Nighttime U-Factor: 0.47 (Btu/hr*ft^{2}*°F) maximum.

c. Summer daytime U-Factor: 0.50 (Btu/hr*ft^{2}*°F) maximum.

d. Shading Coefficient: 0.81 maximum.

e. Solar Heat Gain Coefficient: 0.70 maximum.

f. Outdoor Visible Light Reflectance: 15 percent maximum.

GI-2

Interior, full height, lobby

TYPE Monolithic Clear Glass [Clear 12mm] Clear float glass as manufactured by Vitro Architectural Glass

a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.

b. Heat-Treatment: **[**None**] [**Heat-strengthened, ASTM C 1048, Kind HS**] [**Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201**]**

Specifier Notes: Specify the method of heat treatment. Vitro recommends that heat strengthened glass be specified and used, except where tempered glass is mandated for safety or other purposes by code

c. Glass Thickness: 12mm (1/2") Flat Polish all edges

Performance requirements:

a. Visible Light Transmittance: 85 percent minimum.

b. Winter Nighttime U-Factor: 0.98 (Btu/hr*ft^{2}*°F) maximum.

c. Summer daytime U-Factor: 0.89 (Btu/hr*ft^{2}*°F) maximum.

d. Shading Coefficient: 0.84 maximum.

e. Solar Heat Gain Coefficient: 0.73 maximum.

f. Outdoor Visible Light Reflectance: 8 percent maximum.

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2.4 GLAZING UNITS – TEMPERED, CLEAR

A. Safety Glass: Back-painted on one surface and highly opaque.
   1. Manufacturer: Bendheim or approved equal
   2. Thickness as recommended by manufacturer
   1. Applications: Locations as indicated on drawings.
   2. Color by architect.

2.5 GLAZING UNITS - FIRE-RATED GLASS

A. Fire-Resistance-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings manufactured by O'Keeffe's Inc. SAFTI Division; SAFTIFIRST or equivalent products by Technical Glass Products (TGP).
   1. Applications:
      a. Glazed lites in fire doors.
      b. Other locations as indicated on the drawings.
   2. Labeling: Provide permanent label on fire-rated glazing in compliance with ICC (IBC) and authorities having jurisdiction.
   3. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
   4. Safety Glazing Certification: 16 CFR 1201 Category II.
   5. Glazing Method: As required for fire rating.
   6. Markings for Fire-Rated Glazing Assemblies:

B. Fire-Protection-Rated Glazing: Specialty tempered float glass, clear.
   1. Product: O'Keeffe's Inc. SAFTI Division; SAFTIFIRST SuperLite X-90 or equivalent product by Technical Glass Products (TGP).
   2. Thickness: 3/4 inch.
   3. Weight: 9.0 lbs./sq.ft.
   4. Fire Rating: 90 minutes with hose stream.
   5. Safety Certification: 16 CFR 1201 Category I&II.
   6. IBC Fire Protection Rating: D-H-90 (including hose stream test).

2.9 GLAZING COMPOUNDS

A. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

2.10 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Setting Blocks (Fire-Rated Glazing): Hardwood or calcium silicate; glass width by 4 inches by 3/16 inch thick.

C. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

D. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

E. **Backer Rod:**

1. Provide compressible rod stock backing for sealants in glazing joints where required to control sealant depth, support tooling, and prevent three-sided adhesion.
2. Type: Round, closed-cell polyethylene foam or open-cell polyurethane with outer skin (e.g., SofRod® basis of design), non-gassing, inert, and non-absorptive.
3. Comply with ASTM C1330 Type B (closed-cell) or Type O (open-cell with skin).
4. Sized to provide 25–50 percent compression when inserted into joint.
5. Surface Compatibility: Must be compatible with glazing sealants and not bond to sealant.
6. Temperature Range: Suitable for application temperatures from -40°F to 180°F without degrading physical properties.

2.11 FABRICATION

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Orient pattern and draw of glass pieces in same direction. Place waves in sheet glass parallel to floor.

C. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

D. Grind smooth and polish exposed glass edges and corners.

E. Tinted Glass: Cut clean to avoid edge stress. Nipping will not be permitted.

F. Tempered and Heat Strengthened Glass: Fabricate each light before treatment. Cut to size, provide holes and cutouts required for accessories and other work that is attached to glass, finish edges.
   1. Treat heat strengthened and tempered glass by horizontal process in such a manner as to have roller distortion in a horizontal direction as installed on the building.
   2. Identify tempered glass with a permanent non-removable label.

G. Glazing Gaskets:
   1. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
   2. Except for outside glazed systems, glazing gaskets are to have factory molded corners inside and out and shipped to the destination in full gasket “frames”.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

G. Setting Blocks:
   1. Size and place in accordance with glass manufacturer’s recommendations and design calculations for each project system.
   2. Placement and profile of seting block within the glazing channel shall not inhibit drainage for each fenestration system specified.

3.4 INSTALLATION - INTERIOR FIRE-RESISTIVE GLAZING

A. Conform to manufacturer's installation instructions, recommended glazing products and requirements of referenced UL time-design rating.

3.5 INSTALLATION - GLAZING COMPONENTS

A. Install units according to manufacturer's printed instructions.

B. Install units true, plumb and level. Securely and rigidly anchor units.

C. Adjust units for proper operation.

3.6 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.7 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 08 83 00 - MIRRORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of contract, including General, Supplemental, Special Conditions and other Division 1 specification sections, apply to this section.

1.2 SUMMARY

A. This Section includes the following:
   1. Glass mirrors.
      a. Annealed float glass.
      b. Tempered safety glass.

1.3 REFERENCE STANDARDS

A. ASTM C1036 - Standard Specification for Flat Glass; 2011.

B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

D. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.4 ACTION SUBMITTALS

A. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that full length mirrors, meets or exceeds specified requirements.

B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.7 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

A. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.1 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass; Annealed: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
   1. Thickness: 1/4 inch.
   2. Size: As noted on drawings.
   3. Locations: Above lavatories where indicated on the Drawings.

C. Mirror Glass; Tempered: ASTM C1048, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
   1. Thickness: 1/4 inch.
   2. Size: As noted on drawings.
   3. Locations: Amenity spaces; full height of wall (full length) where indicated on the Drawings.

2.2 ACCESSORIES

A. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.

B. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.4 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION 08 83 00

SECTION 08 90 00 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

B. Related Sections:

1. Division 08 Section 08 11 13 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.

2. Division 23 Sections for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building. Comply with ASCE 7.

1. Wind Loads: Determine loads based on conditions indicated below:
   a. Wind Speed: See structural drawings.
   b. Importance Factor: See structural drawings.
   c. Exposure: See structural drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

E. Windborne-Debris-Impact-Resistance Performance: Provide louvers that pass missile-impact and other wind borne debris protections requirement tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 or AAMA 506.

1. Large-Missile Impact: For aluminum-framed systems located within 30 feet of grade.
2. Small-Missile Impact: For aluminum-framed systems located more than 30 feet above grade.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.
3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of metal finish required.

E. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Interior flange unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

G. Provide subsills made of same material as louvers for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Storm-Resistant, Drainable-Blade Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Airolite Company, LLC (The).
   b. Construction Specialties, Inc.
   c. Ruskin Company; Tomkins PLC.

2. Louver Depth: 9 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
4. Louver Performance Ratings:

   a. Free Area: Not less than 6.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
   b. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area exhaust or intake velocity.
   c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 500 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Vertical Storm-Resistant Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Airolite Company, LLC (The).
   b. Construction Specialties, Inc.
   c. Ruskin Company; Tomkins PLC.

2. Louver Depth: 12 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
4. Louver Performance Ratings:

   a. Free Area: Not less than 6.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
   b. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area exhaust or intake velocity.
   c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 500 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at louvers indicated.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening, unless Bird screening indicated.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch thick.
2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 2 inches.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same finish applied to louvers.
7. Attach blank-off panels with clips.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

C. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00

DIVISION

09

FINISHES

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Fire rated partitions.

E. Acoustic insulation.

F. Exterior sheathing board.

G. Cementitious backing board.

H. Gypsum wallboard.

I. Joint treatment and accessories.

J. Lead Laminated

1.2 RELATED REQUIREMENTS

A. Section 05 40 00 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.

B. Section 06 10 00 - Rough Carpentry: Wood blocking for support of wall-mounted equipment.

C. Section 07 27 26 Fluid Applied Membrane Barriers Water-resistive barrier over sheathing.

D. Section 07 84 46 Firestopping: Top-of-wall assemblies at fire rated walls.

1.3 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ANSI A108.11-SystemDeleted - American National Standard for Interior Installation of Cementitious Backer Units; 2010 (Revised).

C. ANSI A118.9-SystemDeleted - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2010).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

G. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

H. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.

I. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

J. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.

L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

M. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.

N. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

O. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

P. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

Q. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.

R. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2007a (Reapproved 2011).

S. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2014.

T. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.

U. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2015.

V. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

W. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

X. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

Y. ASTM E413 - Classification for Rating Sound Insulation; 2010.

Z. GA-216 - Application and Finishing of Gypsum Board; 2013.

AA. GA-600 - Fire Resistance Design Manual; 2015.

AB. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

AC. ICC-ES ER-4071 - Seismic Connection Details for Gypsum Wallboard Nonbearing Partitions and Suspended Ceilings; 2005.

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittal Requirements, for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing, acoustic seals, and sound control.

C. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

E. Test Reports: For all stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

G. Lead-Laminated Gypsum Board

1. Indicate layout of radiation-protected areas

2. Indicate lead thickness or lead equivalencies of components. Refer to partition types for lead thicknesses.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing gypsum based products of documented experience.

B. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of experience.

C. Radiation Protection Survey: Employ registered X-Ray physicist, certified by American Board of Radiology, for testing specified radiation protective Work and to conduct radiation protection survey of facility after radiation shielding materials are installed.

1. Take radiation measurements and indicate evaluation of measurements in report. Submit report to Architect and Owner upon completion of report.

2. Take radiation measurements in locations indicated by Architect.

D. Radiation Protection Work: Comply with National Council of Radiation Protection (NCRP) Report No. 049 – Structural Shielding Design and Evaluation for Medical Use of X-Rays and Gamma Rays of Energies up to 10 MeV.

1. Comply with requirements of local regulatory agencies where local standards and criteria exceed requirements of NCRP Report No. 049.

E. Provide Control Joints for Gypsum Wallboards per WCB (Wall and Ceiling Bureau) Technical Bulletin. May 2010)

1.6 WARRANTY

A. See Section 01 77 00 Closeout Procedures for additional warranty requirements.

B. Glass Mat Faced Gypsum Sheathing:

1. Provide 12 month manufacturer warranty against deterioration or delamination as a result of unprotected exposure.
2. Provide 5 year manufacturer warranty for product performance.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

E. Fire Rated Assemblies: Provide completed assemblies as indicated on the drawings.

F. Lead Lined Gypsum Bd.: Definition

   1. Lead Equivalence: Thickness of lead that provides same attenuation (reduction of radiation passing through) as material in question under specified conditions. Lead equivalence specified for materials used in diagnostic X-Ray rooms is measured at 150 kV unless indicated otherwise.

2.2 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; G 40 galvanized sheet steel per ASTM A653/A653M, no equivalent coating allowed, with properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Studs: "C" shaped with flat or formed webs with knurled faces.
      a. Stud width: Refer to drawings.
      b. Stud gauge: Limit 20-gage studs for all partition types. unless noted otherwise
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: ASTM C754, C shaped, roll-formed steel, 16-gage x 1-1/2 inch wide flange, minimum.
   4. Furring: Hat-shaped sections, minimum 25 gage, minimum depth of 7/8 inch.

B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.

C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
   1. Products:
      a. Same manufacturer as other framing materials.

D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems of fire rating and movement required.

F. Firestop and Deflection Track: ASTM C645 galvanized sheet steel top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

G. Wallboard Grid Suspension System: ASTM C645, heavy duty galvanized steel grid, direct-hung 1-1/2 inch deep interlocking cross tees and main runners; 1-1/2 inch wide face, 2 foot by 4 foot module. ASTM C635/C635M heavy duty classification.
   1. Manufacturers:
      a. Armstrong World Industries, Inc.: www.armstrong.com.
      b. Chicago Metallic Corporation: www.chicago-metallic.com.
      c. USG Corporation: www.usg.com.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
   4. Paper-Faced Products:
      a. CertainTeed Corporation; Type X Gypsum Board.
      b. Georgia-Pacific Gypsum; ToughRock Fireguard X.
      c. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
      d. USG Corporation; Sheetrock Brand Gypsum Panels.

B. High Impact-Resistant Wallboard:
   1. Application: High-traffic areas and Gymnasium as indicated on drawings.
   2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   5. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   7. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
   8. Type: Fire resistance rated Type X, UL or WH listed.
   9. Thickness: 5/8 inch.
   10. Edges: Tapered.
   11. Products:
      a. National Gypsum Company; Gold Bond Hi-Impact Brand XP Wallboard.
      b. USG Corporation; Fiberock Brand Panels--Mold Tough VHI Firecode Core.

C. Abuse/Moisture/Mold Resistant Wallboard: High-density paperless gypsum and cellulose reinforced wall panels, suitable for paint finish.
   1. Application: High-traffic areas requiring moisture and mold resistance.
   2. Abuse Resistance: Catagory 1, Light Duty in accordance with USG test methodology with joint treatment only.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   4. Water Resistance: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
   5. Unfaced Type: Interior fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M.
   6. Type: Fire-resistance rated Type X, UL or WH listed.
   7. Thickness: 5/8 inch.

8. Edges: Tapered.
9. Products: USG Corporation; Fiberock Aqua-Tough Interior Panels.

D. Backing Board For Wet Areas: One of the following products:
1. Application:
   a. Surfaces behind tile in wet areas including shower surrounds, and shower ceilings.
   b. Parapet backing substrate
   c. Pool and high moisture environments
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9-SystemDeleted or ASTM C1325.
   a. Thickness: 5/8 inch.
   b. Products:
      1) Custom Building Products; Wonderboard: www.custombuildingproducts.com.
      2) USG Corporation; Durock Brand Cement Board: www.usg.com.
      3) National Gypsum; Permabase Cement Board: www.nationalgypsum.com

E. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Type X Thickness: 5/8 inch.
4. Edges: Tapered.
5. Products:
   a. CertainTeed Corporation; Diamondback Glassroc Tile Backer.
   b. Georgia-Pacific Gypsum; DensShield Tile Backer.
   c. National Gypsum Company; Gold Bond Brand e²XP Tile Backer Board.
   d. USG Corporation; Fiberrock Tile Backerboard Panels.

F. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 1/2 inch.
3. Edges: Tapered.
4. Products:
   a. CertainTeed Corporation; ProRoc Interior Ceiling.
   b. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
   c. National Gypsum Company; High Strength Brand Ceiling Board.
   d. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.

G. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
4. Type X Thickness: 5/8 inch.
5. Edges: Square.
6. Glass Mat Faced Products:
   a. CertainTeed Corporation; GlasRoc Brand.
   b. Georgia-Pacific Gypsum; DensGlass Sheathing.
   c. USG Corporation; Securock Glass-Mat Sheathing.

H. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.

1. Paper Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
2. Products:
    a. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant).
    b. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
    c. USG Corporation; Sheetrock Gypsum Linear Panels.

I. Lead Laminated Gypsum Board

1. Lead-Laminated Gypsum Board: Single unpierced layer of sheet lead laminated to back of gypsum board, ASTM C1396/1396M; gypsum core wall panel with additives to enhance fire resistance of core and surfaced with paper on front, back, and long edges; Type X, UL rated.

2.4 ACCESSORIES

A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.

B. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3-1/2 inch.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
3. Products:
    a. CertaPro AcoustaTherm Batts manufactured by CertainTeed Corporation: www.certainteed.com.
    b. Sound Control Batts manufactured by Johns Manville Corporation: www.jm.com.
    c. Sound Attenuation Batt manufactured by Owens Corning Corp: www.owenscorning.com.
    d. QuietTherm manufactured by Knauf Insulation: www.www.knaufusa.com.

C. Acoustic Sealant: Butyl, non-hardening, non-skinning, for use in conjunction with gypsum board.
1. Products:
    a. SC-175 Sound Sealant manufactured by Ohio Sealants, Inc.
    b. Acoustical Sealant manufactured by Tremco Manufacturing Company.
    c. BA-98 manufactured by Pecora Chemical Corporation.
    d. CC-75 manufactured by Mason Industries.

D. Fire-Rated Acoustic Sealant: Acrylic, latex based, skinning, UL classified for use in conjunction with fire-rated gypsum board assemblies.
1. Products:
    a. AC-20 FTR manufactured by Pecora Chemical Corporation.
    b. Sheetrock Acoustical Sealant manufactured by USG Corp.

E. Fire-Rated Sealant: As specified in Section 07 84 00.

F. Water-Resistive Barrier: As specified in Section 07 25 00.

G. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated. Plastic accessories unacceptable.
1. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

H. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Ready-mixed vinyl-based joint compound; dust-control formulation.

a. Plus 3 with Dust Control manufactured by USG.
b. ProForm Lite with Dust-Tech manufactured by National Gypsum.

I. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

J. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

K. Sheetmetal Anchor Plates: ASTM A653/A653M, 16-gage, minimum width 8-inches, length to span between studs and engage equipment to be supported.

L. Aluminum Extrusions: ASTM B221, 6063-T5 alloy, 0.050-inch thickness, clear anodized AA M12 C22 A31.
1. Manufacturers:
a. Fry Reglet Corp.: www.fryreglet.com
b. Gordon, Inc.: www.gordongrid.com
c. Pittcon Industries: www.pittconindustries.com
d. Tamlyn, Xtreme Interiors: www.tamlyn.com
2. Product:
a. Reveal, 1/2 inch wide: Fry, DRM-625-50.

M. Rigid Vinyl Channel Reveal
1. PB Channel reveals manufactured by Vinyl Corp.
2. Size: As indicated on drawings.

N. Sheathing Joint Tape: Pressure sensitive tape.
1. Blueskin WP-200 by Henry Company: www.henry.com

O. Lead Sheets: 99.9 percent pure unpierced virgin lead, free from dross, oxide inclusions, scale, laminations, blisters, and cracks.
1. Sheet Lead shall meet or exceed the Federal Specification QQL-201 F Grade C and ASTM B749-03 Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products, see NCRP reports #33, #35 and #49.
2. Thickness: As determined by Radiation Protection Survey, or not less than 1/16 inch (1.5 mm) if not indicated.

P. Lead Strips: 2 inches (51 mm) wide, unless indicated otherwise, by same thickness as sheet lead laminated on gypsum board.

Q. Lead Discs: 3/8 inch (9.5 mm) diameter lead discs for use with screw heads.

R. Adhesive: Acceptable to radiation protection product manufacturer and capable of adhering lead sheets where required.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
2. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
   1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
   2. Seal perimeter of shaft wall and penetrations with fire-rated acoustical sealant.
   3. Use Coated Glass Mat Gypsum Shaftwall at shaftwalls constructed before building close-in.

3.3 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Seismic Bracing: Laterally brace partitions tied to ceiling or greater than 6 feet in height to the building structure independent of ceiling splay bracing in accordance with ICC-ES ER-4071.

C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
   4. Install firestop track assemblies in accordance with manufacturer's instructions to provide required F and T ratings. Ensure that anchoring devices, back-up material, clip supports, and other materials are consistent with tested and approved assemblies.
      a. Install firestop track at head of fire rated partitions.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
   1. Openings 36-inches wide or less: Two 16-gage.
   2. Openings greater than 36-inches wide: Two 14-gage.

E. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   1. Orientation: Horizontal.
   2. Spacing: At 16 inches on center.

F. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.

G. Blocking: Install treated wood blocking or sheet metal anchor plates in stud cavities. Comply with Section 06 10 00 for wood blocking. Provide support at the following:
   1. Plumbing fixtures
   2. Toilet partitions
   3. Toilet accessories
   4. Architectural woodwork
   5. Casework
   6. Equipment
   7. Lighting fixtures
   8. Wall protection
   9. Wall-supported furniture systems

3.4 CEILING FRAMING

A. Contractor's Option: Ceiling Framing System.
   1. Option No. 1: ASTM C754 using steel furring channels and hat channels.
   2. Option No. 2: Wallboard Grid Suspension System

a. Install systems according to ASTM C636/C636M to support superimposed loads with maximum permissible deflection of 1/360 and maximum surface deviation of 1/8 inch in 10 feet.

B. Level ceiling system to a tolerance of 1/360.

C. Install framing after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

D. Install framing independent of walls, columns, and above-ceiling work.

E. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated.

F. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

G. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

H. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

I. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

J. Laterally brace suspension system.

K. Install bracing as required at exterior soffit locations to resist wind uplift.

L. Sound Control Ceilings: Install ceiling suspension isolators at designated ceilings. Ensure isolators are free hanging and do not contact adjacent construction.
1. Ceiling suspension isolators,
2. Construct ceiling suspension in accordance with the above.
3. Install temporary spacers, 1/4 inch thick around perimeter of floating ceiling. Remove spacers once ceiling has been hung. Should ceiling shift and contact adjacent construction, rehang and reassembled as required to achieve free floating assembly, plumb and true.
4. Seal 1/4 inch wide perimeter joint with acoustic sealant over backer rod.

3.5 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
1. Pack voids of opening frames to maintain continuity of sound isolation.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions. Apply at partition conditions indicated as Sound-Rated. Use Fire-Rated Acoustic Sealant at fire-rated partition assemblies only.
1. Place one bead continuously at the following joint conditions:
a. Partition ends abutting other materials.
b. Partition tops abutting structure.
c. Partition bottom abutting floor.
d. Opening frame perimeter joint to abutting materials.
2. Framed Openings: Seal gypsum board terminations in door and window frames.
3. Covering: Concealed rear surface of utility (mechanical, electrical or plumbing) back box.
4. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

C. Acoustic Seal Tape: Use to close voids where finished end of gypsum board partition abuts a dissimilar material such as a metal mullion or frame. Apply continuous to the abutting surface and install the gypsum board tight against it to provide compression along its entire length. Tape to form an acoustic, vision and light barrier.

3.6 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exterior Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
   1. Apply continuous thermal bridging tape on outboard face of stud flange prior to sheathing installation.
   2. Flash penetrations through sheathing.

F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11-SystemDeleted and manufacturer's instructions.
   1. Install at ceramic tile shower substrate.
   2. Install at parapet backing substrate.

G. Coated Glass Mat Backer Board:
   1. Install at toilet rooms, janitor's closets, and ceramic tile substrate.

H. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.7 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. At construction changes within plane of wall.
   2. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   3. Provide full-height vertical joint each door opening, locate at outside edge, hinge side of door frame.
      a. Ceiling-height door frames shall constitute control joints.
   4. Maintain fire rated construction integrity at fire rated partitions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Aluminum Extrusions: Where indicated. Double miters at trim intersections.

E. Plastic Accessories: Install where indicated. Secure to substrate with staples and adhesive with straight, true lines, smooth curvatures and true transitions.

3.8 INSTALLATION OF LEAD-LAMINATED GYPSUM BOARD

A. Comply with manufacturer's recommendations.

B. Adhere lead strips on face of studs at joints in lead-laminated gypsum board, including inside and outside corners. Use 2 inches (50 mm) wide strips by same thickness as sheet lead laminated on gypsum board.

C. Shim studs and other framing members as necessary to provide flat, flush finished surfaces.

D. Install lead-laminated gypsum board on framing with screws spaced not more than 8 inches (203 mm) on center along edges of board and 12 inches (305 mm) on center in field of board.

E. Adhere lead discs to fastener heads. In each case, use method that provides continuous radiation shielding

F. Where lead-laminated gypsum board is final substrate, apply joint treatment on fasteners and joints.

3.9 INSTALLATION OF PENETRATING ITEMS

A. At penetrations of lead linings; provide lead shields to maintain continuity of protection.

B. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.

C. Cut wall penetration covers from lead sheet of equal or greater thickness than backing on adjacent wall panels. Cut wall penetration covers to size required to cover wall penetrations with laps 1 inch (25 mm) minimum wide as indicated on penetration detail drawings.

D. Adhesive-apply lead sheet penetration covers on penetrating boxes and raceways and return penetration covers to backside of lead-backed wall panels with 1 inch (25 mm) minimum laps.

1. Do not use penetrating fasteners unless indicated otherwise.

2. Outlet Boxes and Conduit: Install between studs using steel telescoping mounting brackets. Cover or line with lead sheet lapped over adjacent lead lining at least 1 inch (25 mm). Wrap conduit with lead sheet for 10 inches (250 mm) in from box.

3.10 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound. Flash penetrations through sheathing.

B. Paperless Gypsum Board: Use paper joint tape, bedded and finished with chemical hardening type joint compound.

C. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

D. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: All walls and ceilings (paper and paperless boards) to receive Level 5 Finish except as noted below.
   2. Level 4: Walls and ceilings to receive wall coverings and graphics, unless otherwise indicated by Architect.
   3. Level 3: None
   4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

E. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling and sanding is not required at base layer of double layer applications.

F. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

G. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.11 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corner
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

3.12 ALTERATIONS TO EXISTING GYPSUM BOARD

A. Butt Joints: Where new gypsum board partitions are required to align flush with existing construction in the same plane, cut existing board away in straight line centered over framing member.
   1. Use rasp or sanding block to slope edges inward at 45 degree angle. Sand existing texture to render smooth surface avoiding damage to face paper. Remove all loose surfacing material.
   2. Install abutting new board and finish as a butt joint with joint tape and compound as required for new work. Finish so there is no evidence of a joint.

B. Intersection Joints: Sand existing texture to render smooth surface avoiding damage to face paper. Install intersecting framing and board. Finish with folded joint tape and compound as required for new work.

C. Finishing: Match finish of existing adjacent gypsum board surfaces so that jointing of new to existing will not be visible in finished surface.

3.13 PARTITION MARKINGS

A. Mark fire-rated partitions and smoke barriers with 3-inch-high upper case letters with 3/8 inch stroke stenciled in red paint.

B. Place markings 6-inches above ceilings both sides of partitions as follows:
   1. Centered over doors.
   2. Maximum 30 feet on center interval and not less than 15 feet from end of partition.
   3. Lettering Copy (as applicable):
      a. "1-HOUR FIRE RATED-PROTECT ALL OPENINGS"
      b. "2-HOUR FIRE RATED-PROTECT ALL OPENINGS"
      c. "SMOKE BARRIER, _#_-HOUR FIRE RATED-PROTECT ALL OPENINGS" (with appropriate fire rating)

C. Mark point of partition type demarcation with 1 inch wide painted vertical line from ceiling line to bottom of structure at the following conditions:
   1. from rated partition type to non-rated partition type;
   2. from change in partition type rating.

3.14 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface (not receiving millwork) from True Flatness: 1/8 inch in 10 feet in any direction.

B. Maximum Variation of Gypsum Board Surface receiving millwork per AWI standards for Premium Grade to be 1/64”

END OF SECTION

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:
   1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
   2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

B. Related Sections include the following:
   1. Division 09 Section 09 22 16 "Gypsum Board".

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. **Framing Members, General:** Comply with ASTM C754 for conditions indicated.

1. **Steel Sheet Components:** Comply with ASTM C645 requirements for metal, unless otherwise indicated.

2. **Protective Coating:** ASTM A653/A653M, G40 hot-dip galvanized, unless otherwise indicated.

3. **Material Thickness Requirement:** Provide *true minimum base steel thickness* as specified, before applica tion of protective coating. **Equivalent Gauge (EQ) studs are not permitted.** Studs shall not include em-

bossments, proprietary stiffening patterns, or other manufacturing modifications intended to match the performance of a heavier stud with reduced base metal thickness.

2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. **Steel Studs and Runners:** ASTM C645.

1. Minimum Base-Metal Thickness: 0.033 inch (20 gauge).
2. Depth: As indicated on Drawings.
3. **EQ studs are prohibited. Only traditional, true-gauge studs meeting the specified base-metal thickness are acceptable.**

B. **Flat Strap and Backing Plate:** Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.018 inch.

C. **Cold-Rolled Channel Bridging:** 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

D. **Hat-Shaped, Rigid Furring Channels:** ASTM C645.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: As indicated on Drawings.

E. **Resilient Furring Channels:** 1/2-inch-deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Hat-shaped.

F. **Cold-Rolled Furring Channels:** 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

G. **Z-Shaped Furring:** With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.1 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install non-load-bearing steel framing in accordance with ASTM C754, manufacturer's written instructions, and approved shop drawings.

B. Provide framing members that comply with the specified minimum base-metal thickness before application of protective coating.

C. Do not use Equivalent Gauge (EQ) studs. Framing members shall not include reduced base-metal thickness, embossments, proprietary stiffening patterns, or other manufacturing modifications intended to simulate the performance of a heavier gauge member.

D. Verify stud sizes, gauges, and spacing on Drawings before installation; ensure only specified true-gauge members are installed.

E. Align studs and runners accurately to required layout; plumb, level, and square. Securely attach to supporting structure to maintain position and stability.

F. Install additional studs, blocking, furring, and bracing as required to support fixtures, equipment, trim, and other applied loads.

G. Space studs as indicated on Drawings, unless otherwise approved in writing by the Architect.

H. Install bridging, bracing, and accessories in accordance with ASTM C754, manufacturer's recommendations, and as indicated on Drawings.

I. Isolate dissimilar metals to prevent galvanic corrosion.

J. Do not make field modifications that reduce member strength or coating integrity.

3.3 INSTALLING SUSPENSION SYSTEMS

A. Suspend hangers from building structure as follows:
   1. Install hangers according to spacings indicated but not greater than spacings required by referenced installation standards for assembly types
      a. 48 inches oc
   2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
   3. Splay hangers only where required to miss obstruction and offset resulting horizontal forces by bracing, countersplaying or other equally effective means

4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards
5. Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceramic tile.

2. Waterproof membrane.

3. Metal edge strips.

B. Related Sections:

1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

2. Division 09 Section "Gypsum Board" for glass-mat, water-resistant backer board.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6

2. Ramp Surfaces: Minimum 0.8

B. ANSI A326.3 Dynamic Coefficient of Friction (DCOF AcuTest) **with** minimum 0.42 for wet interior level surfaces.

C. A326.3 Dynamic Coefficient of Friction (DCOF AcuTest) **with minimum 0.42 for wet interior level surfaces.**

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required

2. Full-size units of each type of trim and accessory for each color and finish required.

3. Certificates/test reports (e.g., for DCOF, waterproof membrane compliance)

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Crack isolation membrane.

2. Joint sealants.

3. Metal edge strips.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS

A. Refer to Finish List and Finish Schedule in Drawings

2.3 TILE PACKING PANELS

A. Refer to Section 09 29 00 Gypsum Board, 2.4 Tile Backing Panels.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. National Gypsum Company, Permabase.
   b. USG Corporation, Durock.
   c. Manufacturer approved by architect.

2. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
   a. Thickness: 1/2 inch (12.7 mm).
   b. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Manufacturers: MAPEI Corporation or approved equal.

2. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.

2.5 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7. Refer to sheet A2.2.7 for selection

1. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

a. Unsanded grout mixture for joints

2. Bond coat: Mortar Bed – ANSI A108.1.A. Portland cement paste on a mortar bed that is still workable or dry set mortar or latex Portland cement mortar on cured bed

3. Bond coat: Mortar BedA108.1.B (thinset over cured mortar beds) **for flexibility.**

2.6 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Urethane Waterproofing and Tile-Setting Adhesive: One-part, liquid-applied urethane in a consistency suitable for trowel application and intended for use as both waterproofing and tilesetting adhesive in a two-step process

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bostik, Inc.; Hydroment Ultra-Set.
b. Boiardi Products Corp.; Elastiment 326

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following

a. Bonsal American; an Oldcastle company; Grout Sealer.
b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer
c. Custom Building Products; Grout and Tile Sealer.
d. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Provide substrate for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards

1. Fill cracks, holes and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer’s written instructions. Use product specifically recommended by tile-setting material manufacturer

2. Remove protrusions, bumps and ridges by sanding

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

1. Extend waterproofing up perimeter, wing and partition walls a minimum of 1/2"

2. For showers (TCNA B421 extend waterproofing to height of showerhead.

B. Do not install tile or setting materials until waterproofing has cured and been tested to determine that it is watertight

3.4 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

1. Provide bullnose-edge tiles at transitions to paint

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Porcelain Tile: 1/16 inch.

2. Glazed Wall Tile: 1/16 inch.

F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

G. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

H. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

I. Lippage tolerances (ANSI A108.02) for floor tile.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 30 00

SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes acoustical tiles for ceilings and the following:

1. suspension systems.

1.3 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Tile: Obtain each type through one source from a single manufacturer.

2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:

1. Surface-Burning Characteristics: Provide acoustical tiles with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical tiles and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to 2.0 percent of quantity installed.

2. Suspension System Components: Quantity of each grid and exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL TILES, GENERAL

A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-

negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL TILES FOR ACOUSTICAL TILE CEILING:

A. Basis-of-Design Product: Refer to Finish Standards for Ceiling Finishes/Specs including manufacturer, size, color, location, etc and for typical details.

B. Classification: Provide acoustic ceiling tiles complying with ASTM E1264, Type III, Form 1, Pattern E (or as noted on the finish schedule).

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

2. In the Natatorium provide Heavy gauge hot dipped galvanized steel wire.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inchdiameter wire.

E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILE CEILINGS: ACT-1 THROUGH ACT-5

A. Basis-of-Design Product: Subject to compliance with requirements, provide a 9/16-inch metal suspension system from the same manufacturer as the ceiling tiles or approved equal.

1. Color: Per Architect's direction.

2. Main and cross runners roll formed from cold-rolled steel sheet.

3. Finish: Pre-painted, electrolytically zinc coated, or hot-dip galvanized per ASTM A 653/A 653M, minimum G30 coating designation.

4. Configure system to accommodate ACT-1 through ACT-5 per ceiling layout and edge type (tegular or non-tegular).

5. Provide all components necessary for proper installation, including trim, splices, and seismic or special-use support as required.

6. Special Conditions:
   a. ACT-1 in MRI rooms: Use non-ferrous grid compatible with MRI equipment.
   b. Trim: Provide Compass trim or other manufacturer-recommended trim as indicated on drawings or required for wall abutments and special conditions.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dipped galvanized according to ASTM A 653/A 653M, not less than 630 coating designation, with prefinished 15/16 wide metal caps on flanges.

2.4 METAL EDGE MOLDINGS AND TRIM

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc

2. BPB USA;

3. Chicago Metallic Corporation;

4. Fry Reglet Corporation;

5. Gordon, Inc

6. USG Interiors, Inc.;

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical tile edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.

2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical tile ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, SUSPENDED ACOUSTICAL TILE CEILINGS

A. General: Install acoustical tile ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

3. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

6. Do not attach hangers to steel deck tabs.

7. Do not attach hangers to steel roof deck. Attach hangers to structural members.

8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 23

SECTION 09 54 16 - LUMINOUS SKY-IMAGE CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Luminous sky-image ceilings with LED backlighting.

1.2 RELATED REQUIREMENTS

A. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies.

B. Section 13 09 50 RF Shielding (& Owner's CDC package)

C. Division 26 - Electrical: Power and lighting connections.

1.3 REFERENCE STANDARDS

A. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

B. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

1.4 SUBMITTALS

A. Product Data and Shop Drawings.

B. Image tile samples and artwork for review.

C. Manufacturer’s installation and maintenance instructions.

1.5 QUALITY ASSURANCE

A. Manufacturer and Installer Qualifications: Minimum 5 years’ experience.

B. In place Mock-up for Architect’s review and approval

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in manufacturer’s packaging. Store dry, indoors, at stable temperature.

1.7 WARRANTY

A. Provide manufacturer’s 10-year limited warranty against visible image tile fading.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: Sky Factory, Inc. or approved equal.

2.2 SKY-IMAGE CEILING SYSTEM

A. LED Light Boxes:

1. 6500K daylight LED, RFI-free, uniform backlighting.

2. UL & CE labeled. Mounting depth as scheduled.

B. Image Tiles:

1. UV-resistant printed media laminated between acrylic or polycarbonate.

2. Image: As Selected by Architect.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify conditions and readiness before beginning installation.

3.2 INSTALLATION

A. Install light boxes and image tiles in accordance with manufacturer’s instructions.

B. Connect to electrical systems under Division 26.

3.3 CLEANING

A. Clean finished surfaces and ensure uniform lighting.

3.4 SCHEDULE

A. Refer to drawings for artwork orientation and grid layout.

09 54 23 LINEAR METAL CEILING PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

a) Section Includes:

1. Metal ceiling panels
2. Exposed grid suspension system.
3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

b) Related Sections:

1. Section 09 51 23 - Acoustical Tile Ceiling
2. Section 09 21 16 - Gypsum Board Assemblies
3. Section 09 22 16 - Non-Structural Metal Framing

1.3 REFERENCES

a) American Society for Testing and Materials (ASTM):

1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process.
3. ASTM A 1008 Standard Specification for Steel, Sheet, and Cold Rolled Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
4. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
6. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
7. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
9. Underwriters Laboratories Incorporated
10. ASTM E 580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
11. UL 580 Underwriters Laboratories, Inc., Standard for Safety, Test for Uplift Resistance of Roof Assemblies
12. ASTM E 1264 Classification for Acoustical Ceiling Products.
13. International Building Code
14. ASHRAE Standard 62 1 2004 Ventilation for Acceptable Indoor Air Quality
15. NFPA 70 National Electrical Code
16. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
17. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
18. International Code Council-Evaluation Services Report - Seismic Engineer Report

1.4 SUBMITTALS

a) **Shop Drawings**: Provide drawing of DesignFlex Ceiling Pattern Layout including panel type and components used in the assembly of the ceiling. Show locations of items that are to be coordinated with, or supported by the ceilings.

b) **Installation Instructions**: Submit manufacturer's installation instructions as referenced in Part three, Installation.

c) **Samples:** Minimum 3 inch x 5/8 inch samples of specified wood panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

d) **Product Data:** Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

e) **Certifications:** Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.5 QUALITY ASSURANCE

a) Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.

b) Fire Sprinklers: Ceiling systems may obstruct or Skew the planned water distribution pattern of fire sprinkler. In addition to creating a possible delaying or accelerating the activation of the sprinkler of fire detection system. Consult with a fire protection engineer for guidance

c) Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.

    1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.

        i. Flame Spread: 25 or less

        ii. Smoke Developed: 50 or less

    2. Underwriter Laboratories Inc. certification and audit program as tested per ASTM E-84 tunnel test.

d) Wind Uplift Performance Characteristics: Identity ceiling components with applicable testing.

    1. Wind Uplift Characteristics: as follows, tested per UL580 with resulting test performance.

        i. Class 30, Class 60 or Class 90 Wind Uplift Classification

e) Fire Sprinklers: Ceiling systems may obstruct or Skew the planned water distribution pattern of fire sprinkler. In addition to creating a possible delaying or accelerating the activation of the sprinkler of fire detection system. Consult with a fire protection engineer for guidance.

f) Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE, AND HANDLING

a) Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

b) Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

c) Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.7 PROJECT CONDITIONS

a) Space Enclosure:

    I. HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance

and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.8 WARRANTY

a) Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

II. 1. Acoustical Metal Panels: Sagging and warping

III. 2. Grid System: Rusting and manufacturer's defects

b) Warranty Period:

I. Acoustical Linear Metal panel System: One (1) year from date of substantial completion

c) The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.10 MAINTENANCE

a) Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Ceiling Units: Furnish quality of full-size units equal to 2.0 percent of amount installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

a) Basis of Design MetalWorks Linear Systems:

1. Armstrong World Industries, Inc. or approved equal meeting all performance and installation requirements.

b) Suspension Systems:

1. Armstrong World Industries, Inc.

2.2 CEILING UNITS

a) Linear Panels:

1. Surface Texture: Smooth
2. Composition: Metal
3. Colors: See
4. Edge Profile: Square with extended flange 15/16
5. Light Reflectance (LR) White Panel: ASTM E 1477; Unperforated 0.77, Micro Perforated 0.61
6. Perforation Options: Unperforated, Microperforated
7. Acoustical Performance based on Noise Reduction Coefficient ASTM C 423 (NRC)
    i. Microperforated
        1. 0.70 with fleece
        2. 0.85 with Fiberglass Infill
8. Flame Spread: Class A
9. Dimensional Stability: HumiGuard Plus.

b) Accessories: 2.2.1 SUSPENSION SYSTEMS

c) Components: All main beams and cross tees shall be commercial quality hot dipped galvanized steel as per ASTM A653. Main beams and cross tees are double-web steel construction with 9/16 inch type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

d) Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

e) Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least times-three design load, but not less than 12 gauge.

f) Accessories/Edge Moldings and Trim:

a. Item: 5574 Carrier Molding
b. 6” Wood Looks Trim – Color:
c. Items Varies: Axiom® Trim

PART 3 - EXECUTION

3.1 EXAMINATION

a) Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

b) Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

a) Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

a) Install suspension system and panels in compliance with ASTM C636, ASTM E580, with the approval of the authorities having jurisdiction, and in accordance with the manufacturer's MetalWorks Linear Installation Instructions

3.4 ADJUSTING AND CLEANING

a) Replace damaged and broken panels.

b) Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

END OF SECTION

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Resilient base.

B. Related Sections:
Division 09 Section09 65 19 "Resilient Tile Flooring" for resilient floor tile.
Division 09 Section 09 68 13 “Tile Carpeting” for tile carpeting

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

C. Product Schedule: Refer to Finish Standards

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive resilient products during the following time periods: 48 hours before installation. During installation.48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg or more than 95 deg F

C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE

A. Resilient Wall Base: Manufacturers: Subject to compliance with requirements, provide products by the following:

1. **RB-1 – Mohawk Cove Base**
   a. Basis of Design: Mohawk, Cove Base
   b. Or approved equal

   Design
   Product Type: Rubber
   Gauge: 1/8”
   Size, profile and color" per finish standards in drawings

   Performance
   Composition: Proprietary TP Rubber formulation including pigments, stabilizers, and other functional fillers
   Critical Radiant Flux: ASTM E648 – Class I (> 0.45 W/cm²)
   Fire Resistance: ASTM E84 – Class II (26–75)
   Flame Propagation: UL 992 – < 2.0
   Resilient Wall Base Standard: ASTM F1861 – Conforms

   Service
   Warranties: Limited 10-Year Warranty

2. **RB-2 – Mohawk Straight Base**
   a. Basis of Design: Mohawk, Straight Base
   b. Or approved equal

   Design
   Product Type: Rubber
   Gauge: 1/8”
   Size, profile and color" per finish standards in drawings

   Performance
   Composition: Proprietary TP Rubber formulation including pigments, stabilizers, and other functional fill-

ers
Critical Radiant Flux: ASTM E648 – Class I (> 0.45 W/cm²)
Fire Resistance: ASTM E84 – Class II (26–75)
Flame Propagation: UL 992 – < 2.0
Resilient Wall Base Standard: ASTM F1861 – Conforms

Warranties: Limited 10-Year Warranty

3. **RB-3 – Tarkett Mandalay Base**
a. Basis of Design: Tarkett, Mandalay
b. Or approved equal

Design
Product Type: Rubber
Gauge: 1/8”
Size, profile and color" per finish standards in drawings

Performance
Composition: Proprietary TP Rubber formulation including pigments, stabilizers, and other functional fillers
Critical Radiant Flux: ASTM E648 – Class I (> 0.45 W/cm²)
Fire Resistance: ASTM E84 – Class II (26–75)
Flame Propagation: UL 992 – < 2.0
Resilient Wall Base Standard: ASTM F1861 – Conforms

Warranties: Limited 10-Year Warranty

B. Outside Corners: Job formed for all types
C. Inside Corners: Job formed for all types
D. Color: Per finish standards in drawing

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. Rubber Floor Adhesives: Not more than 60 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.
Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Job-Formed Corners:
   a. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
   b. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   a. Remove adhesive and other blemishes from exposed surfaces.
   b. Sweep and vacuum surfaces thoroughly.
   c. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 – GENERAL INFORMATION

1.01 SUMMARY

A. This section deals with resilient flooring found in the drawings and schedules of the contract that meet the requirements of this section.

1.02 RELATED SECTIONS

A. Section 3 – Cement: not covered in this section.

B. Section 6 – Wood and plastic: not covered in this section.

C. Section 7 – Thermal and humidity protection: not covered in this section.

D. Section 9 – Other sections containing information related to floor finishes: not covered in this section.

1.03 REFERENCES (INDUSTRY STANDARDS)

A. ASTM F 710: Practice for Preparing Concrete Floors to Receive Resilient Flooring.

B. ASTM E 648: Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

C. ASTM E 662: Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

D. ASTM F 1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

E. ASTM F 2170: Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes.

1.04 ITEMS TO DELIVER

A. Provide the product's Technical Specifications data sheet as well as all installation and maintenance instructions.

B. When required, supply floor drawings and installation plans.

C. Supply a set of samples measuring at least 3 in. (7.5 cm) by 6 in. (15 cm) of the complete range of colors and finishes chosen for the project.

D. When required, provide Mohawk Group's attestation, certified by an independent laboratory, confirming that the flooring complies with the fire standards of the following tests:

1. ASTM E 648; Critical Radiant Flux: 0.45 watts/cm^2 or more.

2. ASTM E 662; Smoke Density: 450 or less.

E. Provide Mohawk Group's Warranty Certificate.

1.05 QUALITY ASSURANCE

A. Have Mohawk Group flooring installed by an installer qualified in the installation of resilient flooring.

B. In accordance with the technical instructions in the installation instructions, use all accessories recommended by Mohawk Group when installing its flooring.

C. Follow the instructions specified in the most recent version of Mohawk Group's installation instructions.

1.06 DELIVERY, HANDLING, STORAGE

A. Deliver the flooring to the installation site in Mohawk Group's original packaging. Indicate the project name and handling instructions on the outside of the boxes.

B. Advise the carrier of any damaged material and indicate it on the packing slip.

C. Store the flooring inside, sheltered from extreme hot or cold temperatures. Place the material on a smooth level floor or where there is uniform solid support in a clean, dry, well-ventilated area. The long-term storage temperature must be maintained between 65°F (18°C) and 85°F (29°C). Protect adhesive and flooring material from freezing, extreme heat and direct sun exposure.

D. Acclimatize the subfloor, all flooring material and adhesive for 48 hours before, during and after the installation by maintaining the room temperature between 65°F (18°C) and 85°F (29°C). The pallets should be unstacked 24 hours prior to use.

E. Afterwards, maintain the room temperature between 65°F (18°C) and 85°F (29°C). Protect the material from direct sources of heat such as air vents and other types of heaters.

F. Install the flooring after all other finishing work, including painting, has been completed.

PART 2 - PRODUCTS

2.01 MANUFACTURER

Mohawk Group, 160 S. Industrial Blvd, Calhoun GA 30701 Telephone 800.241.4494.
Website: www.mohawkgroup.com
Contact: Vickie Small
504-432-3183
vickie_small@mohawkind.com

Substitutions or Equals:

1. Substitutions are allowed only if they meet the following criteria:

   a. Acceptance of alternate product(s) that are accepted as equals must be approved by parties (including, but not limited to) that have material interest in the specifications including: Designer, Architect, End-User, and Flooring Contractor.

2.02 MATERIALS

DETAILED PRODUCT CONSTRUCTION SPECIFICATIONS

Style Name	**Bolder 2.5mm (C2107)**
Collection	Hot and Heavy II
Product Type	LVT
Overall Thickness	2.5mm
Wear Layer	20 mil (0.5 mm)
Finish	M-Force™ Ultra
Size	18 in X 36 in
Emboss Overall	
Bevel	Straight Edge
Installation & Adhesive	2.5mm Glue Down
Packaging	Flex 2.5mm 12 pcs per carton / 54 sq ft per carton
Sustainability	
Country of Origin	South Korea
Mindful Materials	Participates in Mindful Materials Library
Environmental Product Declaration	Hot and Heavy LVT EPD
Beyond Carbon Neutral	-0.595

Embodied Carbon	11.9 kg CO2e/sq m2
Carbon Handprint	-12.5 kg CO2e/sq m2

Style Name	**Chromascope 2.5 C2113**
Collection	Hot and Heavy II
Product Type	Flexible LVT
Overall Thickness	2.5 mm
Wear Layer	20 mil (0.5 mm)
Finish	M-Force™ Ultra
Surface Profile	Overall
Edge Profile	Squared
Size	18” x 36”
Square Feet Per Carton	54
Pounds Per Carton	46.46
Installation Method	Glue Down
Installation	Monolithic, Brick Ashlar, Vertical Ashlar, Random
Classification	ASTM F1700, Class III, Type B - Embossed
Sustainability	
Embodied Carbon	6.43 kg CO2e/sq m2
MindClick Rating	Achiever

Style Name	**Secoya 2.5 C2103**
Collection	Hot and Heavy II
Product Type	LVT
Overall Thickness	2.5 mm
Wear Layer	20 mil (0.5 mm)
Finish	M-Force™ Ultra
Surface Profile	Embossed
Edge Profile	Micro-Beveled
Size	7” x 48”
Square Feet Per Carton	41.99
Pounds Per Carton	36
Installation Method	Glue Down
Installation	Monolithic, Brick Ashlar, Vertical Ashlar, Random
Classification	ASTM F1700, Class III, Type B - Embossed
Sustainability	
Embodied Carbon	6.43 kg CO2e/sq m2
Beyond Carbon Neutral	-0.3215
MindClick Rating	Achiever

Mohawk’s LVT is not recommended for environments where it could be exposed to oils and greases whether mineral, animal or vegetable.

Refer to the product’s Technical Specifications data sheet for detailed specifications.

Choose from any of Mohawk Group’s complete line of colors (indicate the item number).

All specifications are subject to normal manufacturing tolerances

2.03 ADHESIVE

M99 Adhesive (up to 99% in-situ RH and a pH of 12.0)
M95.0 Adhesive (up to 95% in-situ RH and a pH of 8 - 10.0)
M700 Adhesive (up to 90% in-situ RH and a pH of 7 – 9)
Total Bond Adhesive (100% in-situ RH and pH testing not required)

2.04 OTHER MATERIAL

A. Subfloor repairs: use a good-quality Portland cement-based compound modified with latex that has a minimal resistance to compression of 3500 lbs/sq. in. (246 kg/cm^2). to fill, smooth and/or level subfloor imperfections.

B. Self-levelling underlayment: use a Portland cement-based self-levelling underlayment modified with a polymer that has a minimal resistance to compression of 3500 lbs/sq. in. (246 kg/cm^2).

PART 3 – EXECUTION

3.01 SITE INSPECTION

A. Examine the subfloor before installation to ensure that the surface is clean, dry, smooth, structurally sound and free from foreign substances that may adversely affect adhesion or cause discoloration. Furthermore, ensure that the subfloor is free of paint, varnish, adhesive, oil, grease, solvent and other foreign substances, including treatment compounds, sealers and curing compounds that may adversely affect adhesion or alter the appearance or durability of the resilient flooring.

B. Verify the surface to ensure there is no powder, scaling or mold. If found remove with a mechanical sander and level with a good-quality Portland cement-based self-levelling underlayment modified with a polymer that has a minimal resistance to compression of 3500 lbs/sq. in. (246 kg/cm^2).

C. Slabs that have been either using a curing agent or a sealer will have to be treated to ensure that the adhesion has not been impaired.

D. Do not install on cement slabs that have been subjected to adhesive chemical abatement unless an approved remediation system was used afterwards.

E. Report and rectify all unsatisfactory conditions. Do not start flooring installation until all rectifications have been completed.

3.02 SUBFLOOR PREPARATION

A. Level all rough surfaces and fill cracks and marks with a Portland cement-based patching compound modified with latex.

B. Mechanically remove all surface contaminants such as paint, oil, grease, varnish, adhesive as well as various other products such as treatment compounds.

C. Measure the humidity and pH levels (in situations where pH testing is required) in compliance with the following standards before installation:

1. ASTM F 2170, Relative Humidity (RH) test using in situ probes.
2. ASTM F 710, pH levels (test procedure 5.3.1).
3. The ASTM test frequency recommendation is 3 measures for the first 1,000 sq. ft. (92.9 sq. m) and one measure for each additional 1,000 sq. ft. (92.9 sq. m).

D. Ensure Moisture, Relative Humidity and pH tests have all been conducted and measurements meet manufacturer's recommendations.

E. In case of doubt, test the adhesion on the cement subfloor or other surface that will be covered by the flooring. Do the test using the specified flooring and recommended adhesive.

3.03 RESILIENT FLOORING INSTALLATION

A. Install the flooring according to the latest version of Mohawk Group's installation instructions. Use the tools, adhesives, trowel types and procedures recommended in the instructions.

B. Acclimatize the subfloor, all flooring material and adhesive for 48 hours before, during and after the installation by maintaining the room temperature between 65°F (18°C) and 85°F (29°C). Afterwards, maintain the temperature between 65°F (18°C) and 85°F (29°C).

3.04 CLEANING AND PROTECTION

A. Remove all excess adhesive immediately after installation as recommended in Mohawk Group's installation instructions.

B. Before allowing traffic after installation, consult and follow the recommendations in Mohawk Group's installation instructions.

C. Following installation and cleanup, if the work of all other trades has not yet been completed, protect the flooring by laying sheets of non-staining brown Kraft paper and then a layer of plywood sheets (rolls of non-staining heavy cardboard material could also be used for protection).

D. Follow the instructions in Mohawk Group's Maintenance Instructions when performing initial and regular maintenance procedures.

Please note that technical website documents prevail.

END OF SECTION

SECTION 09 65 66. 13 - RESILIENT SHEET ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Homogeneous rubber sheet sports flooring

B. Related Sections include the following:

1. Division 09 Sections for resilient floor coverings installed in areas other than athletic-activity spaces.
2. Division 09 Section "Resilient Base and Accessories" for wall base and accessories installed with floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details and locations of the following:

1. Floor patterns.
2. Layout, colors, widths, and dimensions of game lines.
3. Locations of floor inserts for athletic equipment.
4. Seam locations.

C. Samples for Initial Selection: For each type of floor covering indicated.

1. Game-Line and Marker Paint: Include charts showing available colors and glosses.

D. Samples for Verification: For each type, color, and pattern of floor covering indicated, 6-inch-square Samples of same thickness and material indicated for the Work.

1. Game-Line and Marker-Paint Samples: Include sample sets showing game-line and marker-paint colors applied to floor coverings.
2. Seam Samples: For each sheet floor covering color and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

E. Qualification Data: For homogenous sheet sports floor covering Installer.

F. Maintenance Data: For floor coverings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Sheet Installer Qualifications: An experienced installer who has completed sheet vinyl floor covering. installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project, who is acceptable to manufacturer, and whose work has resulted in installations with a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration. Store rolls upright.

1.6 PROJECT CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor coverings during the following time periods:

    a. 48 hours before installation, unless longer period is recommended in writing by manufacturer.
    b. During installation.
    c. 48 hours after installation, unless longer period is recommended in writing by manufacturer.

2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
3. Close spaces to traffic during floor covering installation.
4. Close spaces to traffic for 48 hours after floor covering installation, unless manufacturer recommends longer period in writing.

B. Install floor coverings after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Sheet Floor Coverings: Furnish full-width rolls of not less than 10 linear feet for each 500 linear feet or fraction thereof, of each type, color, and pattern of floor covering installed.

PART 2 - PRODUCTS

2.1 HOMOGENOUS SHEET SPORTS FLOORING

A. Basis of Design **Gerflor / Taraflex Sports Flooring** or approved equal.

B. Homogeneous sheet sports floor Covering with Backing: ASTM F 1303

1. Type (Binder Content): I, minimum binder content of 90 percent.
2. Wear-Layer Thickness: Grade 1.
3. Overall Thickness: 0.1 inches.
4. Interlayer Material: Foamed plastic.
5. Backing Class: Class B (nonfoamed plastic).

C. Installation Method: Adhered.

D. Seaming Method: Heat welded.

E. Traffic-Surface Texture: Smooth.

F. Applied Finish: Field-applied polyurethane.

G. Roll Size: Not less than 48 inches (1219 mm) wide by longest length that is practical to minimize splicing during installation.

H. Color and Pattern: As selected by Architect from manufacturer's full range.

I. Accessories:

1. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by floor covering manufacturer.
2. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

    a. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Heat-Welding Bead: Solid-strand product of floor covering manufacturer matching field color of floor.
4. Game-Line and Marker Paint: Complete system including primer, if any, compatible with floor covering and recommended in writing by floor covering and paint manufacturers for use indicated.

    a. VOC content: Provide products with VOC content not more than 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of floor coverings.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended in writing by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture Testing:

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

        1) Perform tests so that each test area does not exceed 200 sq. ft. and perform not less than 2 tests in each installation area and with test areas evenly spaced in installation areas.

    b. Perform tests recommended in writing by manufacturer. Proceed with installation only after substrates pass testing.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation, unless manufacturer recommends a longer period in writing.

1. Do not install floor coverings until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOOR COVERING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit floor coverings to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend floor coverings into toe spaces, door reveals, closets, and similar openings, unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on floor coverings. Use nonpermanent, nonstaining marking device.

E. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and floor covering manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 SHEET FLOOR COVERING INSTALLATION

A. Unroll sheet floor coverings and allow them to stabilize before cutting and fitting. Contractor to discard any portion of rolls which do not stabilize and remain deformed from rolling.

B. Lay out sheet floor coverings as follows:

1. Maintain uniformity of floor covering direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas.
3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.

C. Seams: Prepare and finish seams to produce surfaces flush with adjoining floor covering surfaces.

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering.

3.5 GAME LINES AND MARKERS

A. Mask floor coverings at game lines and markers, and apply paint to produce sharp edges.

1. Where cross, break minor game line at intersection; do not overlap lines.
2. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.

3.6 FIELD-APPLIED FINISHES

A. Apply finish after game-line and marker paint is fully cured.

B. Apply finish according to manufacturer's written instructions to produce a sealed surface that is ready for use.

C. Do not cover floor coverings after finishing until finish reaches full cure.

3.7 CLEANING AND PROTECTING

A. Perform the following operations immediately after completing floor covering installation:

1. Remove adhesive and other blemishes from floor covering surfaces.
2. Sweep and vacuum floor coverings thoroughly.
3. Damp-mop floor coverings to remove marks and soil.

a. Do not wash floor coverings until after time period recommended in writing by manufacturer.

B. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over floor coverings. Protect floor coverings with plywood or hardboard panels to prevent damage from storing or moving objects over floor coverings.

END OF SECTION 09 65 66.13

SECTION 09 65 66.16 – POURED RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Seamless, poured-in-place polyurethane athletic flooring system installed over a resilient rubber base mat.
2. Game-line and marking paint system.

B. Related Sections include the following:

1. Division 03 Sections for concrete substrates, tolerances, and moisture control.
2. Division 09 Section "Resilient Base and Accessories" for wall base and accessories installed with athletic flooring.
3. Division 09 Section “Painting” for striping or painting outside of athletic flooring areas.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Show installation details and locations of the following:

1. Floor patterns.
2. Layout, colors, widths, and dimensions of game lines.
3. Locations of floor inserts for athletic equipment.
4. Transition and termination details.

C. Samples for Initial Selection:

1. For each type of flooring system indicated.
2. Game-Line and Marker Paint: Include charts showing available colors and glosses.

D. Samples for Verification:

1. For each type, color, and texture of flooring system indicated, 6-inch-square samples of same thickness and composition indicated for the Work.

2. Game-Line and Marker-Paint Samples: Include sample sets showing game-line and marker-paint colors applied to flooring material.

E. Qualification Data: For manufacturer and installer.
F. Maintenance Data: For flooring systems to include in maintenance manuals.
G. Warranty Documentation: Manufacturer's and installer's warranties.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with not less than 10 years' experience producing poured polyurethane athletic flooring systems.
B. Installer Qualifications: An experienced installer approved and trained by manufacturer for installation of system type indicated.
C. Mockups: Provide a minimum 100 sq. ft. sample area of the specified system for review of finish, color, and game-line marking. Approved mockup may remain as part of completed Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name, product identification, and directions for storage and handling.
B. Store materials to prevent deterioration. Store indoors, elevated off the floor, in dry, well-ventilated conditions.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:

1. Maintain ambient and substrate temperatures between 65 and 85 deg F and relative humidity below 75 percent during installation and for not less than 48 hours before and after installation, unless otherwise recommended by manufacturer.
2. Provide adequate ventilation during installation and curing periods.
3. Do not install materials until spaces are enclosed, dry, and conditioned to the proper environmental range.
4. Close spaces to traffic during installation and for at least 48 hours after completion, or longer as recommended by manufacturer.
   B. Substrate Conditions:
5. Verify concrete substrate meets ASTM F710 requirements.
6. Moisture vapor emission rate: Maximum 3 lbs/1000 sq. ft./24 hours per ASTM F1869.
7. Relative humidity in concrete: Maximum 75 percent per ASTM F2170.
8. Substrate pH: Maximum 9.
   C. Slab Depression: **9 mm (3/8 inch)** below adjacent finished floor elevations to accommodate full system thickness.

1.7 EXTRA MATERIALS

A. Furnish extra materials before installation begins, packaged with protective covering for storage and identified with labels describing contents.

1. Flooring Repair Material: Sufficient to cover minimum 100 sq. ft. of each color and texture used.
2. Game-Line Paint: One quart of each color used.

1.8 WARRANTY

A. Manufacturer's Warranty: Provide Robbins standard 5-year system warranty covering defects in materials and workmanship.
B. Installer's Warranty: Provide one-year warranty for installation workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Product: **Pulastic® Multisport Classic 110** by Robbins Sports Surfaces.
B. Substitutions: In accordance with Division 01 requirements.

2.2 SYSTEM DESCRIPTION

A. Poured, seamless polyurethane athletic flooring system consisting of the following layers:

1. Base Mat: Prefabricated, recycled rubber mat, nominal 6 mm thick.
2. Pore Sealer: Polyurethane primer/sealer for base mat.
3. Wear Layer: Two-component polyurethane self-leveling coat, nominal 2 mm thick.
4. Topcoat: Pigmented, wear-resistant polyurethane finish.
5. Game-Line Paint: Compatible polyurethane-based marking paint.
6. Total System Thickness: Approximately 9 to 11 mm.

2.3 PERFORMANCE REQUIREMENTS

A. System shall meet or exceed the following standards:

1. Shock Absorption: 25–35% (EN 14808).
2. Ball Rebound: ≥98% (EN 12235).
3. Vertical Deformation: ≤2.3 mm (EN 14809).

4. Resistance to Indentation: ≤0.5 mm (EN 1516).
5. Slip Resistance: 80–110 Pendulum Value (EN 13036-4).
6. Fire Resistance: ASTM E648, Class 1.
7. VOC Content: ≤100 g/L per 40 CFR 59 Subpart D.

2.4 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
B. Game-Line and Marker Paint: Polyurethane system compatible with flooring materials.
C. Maintenance Coating: As recommended by manufacturer.

2.5 COLOR AND FINISH

A. Color and Texture: As selected by Architect from manufacturer's full range.
B. Game-Line Colors: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
B. Verify that substrates are free of cracks, ridges, depressions, and foreign deposits that might interfere with adhesion.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of poured polyurethane system.
B. Mechanically prepare concrete surface to remove laitance, sealers, and contaminants.
C. Verify substrate moisture and pH levels meet requirements before installation.
D. Fill cracks, holes, and depressions with approved leveling compound.
E. Vacuum clean prepared substrate to remove all dust and debris immediately before installation.

3.3 INSTALLATION

A. Comply with manufacturer's written installation instructions and approved mockup.
B. Apply primer, base mat, pore sealer, wear coat, and topcoat in sequence and thicknesses recommended by manufacturer.

C. Maintain uniform color, texture, and thickness across floor area.
D. Provide seamless surface, free of ridges, voids, or imperfections.

3.4 GAME LINES AND MARKINGS

A. Mask flooring and apply game-line paint after surface has fully cured.
B. Apply lines and markers in widths and colors indicated on Drawings.
C. Apply paint evenly to produce sharp, clean edges.

3.5 FIELD-APPLIED FINISHES

A. Apply any required finish or protective coat per manufacturer's instructions.
B. Allow full cure before exposing floor to traffic or further finishing operations.

3.6 CLEANING AND PROTECTING

A. Immediately after installation, remove all excess materials and clean surfaces per manufacturer's written recommendations.
B. Protect flooring from construction traffic, moisture, and contaminants for minimum seven (7) days or until full cure has been achieved.
C. Do not move heavy or sharp objects directly over flooring. Use protective panels as required.

END OF SECTION 09 65 66.16

SECTION 09 66 23 - EPOXY TERRAZZO

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Epoxy terrazzo with divider and accessory strips.

1.02 DEFINITIONS

A. NTMA: National Terrazzo and Mosaic Association, Inc.

1.03 PREINSTALLATION MEETINGS

A. Pre installation Conference: The General Contractor shall conduct a conference at project site before Terrazzo Contractor begins installation.

1. The General Contractor shall invite Terrazzo Contractor, the Architect and representatives of the Owner.
2. Review methods and procedures related to terrazzo including, but not limited to, the following:

a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.

b. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.

c. Review terrazzo mixes and patterns.

d. Review custom terrazzo mixes, designs and patterns.

e. Coordination with the work of other installers.

1.04 ACTION SUBMITTALS

A. Product Data: Terrazzo Contractor shall submit Product Data for each type of product required for installation including:

1. Strip materials.
2. Sealer.
3. Epoxy resins

B. Shop Drawings: Terrazzo Contractor shall prepare and submit Shop Drawings that include plans, elevations, sections, component details and attachments to other work. Include terrazzo installation requirements. Show layout of the following:

1. Divider strips.
2. Expansion joint strips.
3. Terrazzo patterns.

C. Samples for Verification: Terrazzo Contractor shall prepare and submit samples for each type, material, color and pattern of terrazzo and accessory required showing the full range of color, texture and pattern variations expected.

1. Terrazzo: Minimum of 3 pieces each of Architect selected 4 inch by 4 inch samples
2. Accessories: 6 inch long Samples of each type and kind of exposed strip item required

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: Terrazzo Contractor shall submit two copies of qualification data.

1. Include letter from NTMA with the name of the Project and name of member, stating current member status.

B. Material Certificates:

1. Epoxy Resin: For each type of resin required indicating that materials meet specification requirements, by manufacturer.
2. Aggregate: For each type of aggregate required indicating compatibility with terrazzo mix, signed by aggregate supplier.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Literature: Terrazzo Contractor shall submit two copies of maintenance recommendations from NTMA.

1.07 QUALITY ASSURANCE

A. Acceptable Epoxy Resin Manufacturer: An Associate Member of the NTMA, experienced in manufacturing epoxy resin in accordance with NTMA standards and with a record of successful in-service performance, as well as sufficient production capacity to produce required materials.

B. Acceptable Terrazzo Contractor: A Contractor Member of NTMA whose work has resulted in construction with a record of successful in-service performance.

1. Installer shall have completed terrazzo installations within the past 5 years of scale and complexity similar to the proposed installation.

C. Source Limitations for Aggregates: Terrazzo Contractor shall obtain each color, grade, type and variety of granular materials from sources with resources to provide materials of consistent quality in appearance and physical properties.

D. Mockups: Terrazzo Contractor shall construct mockup if required in bid or scope of work documents to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup as indicated on Drawings.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to Project site in supplier's original wrappings and containers, labeled with source or manufacturer's name, material or product brand name, and lot number if any.

B. Materials shall be stored in their original, undamaged packages and containers, in a location where they will not be exposed to direct sunlight.

1. Epoxy components shall be stored in a space where the ambient temperature can be maintained 60 and 90 deg. F before use.

1.09 PROJECT CONDITIONS

A. General Contractor shall provide sufficient water, temporary heat and light, and adequate electric power with suitable outlets connected and distributed for use within 100 feet of any working space.

B. General Contractor shall provide temporary enclosures and other suitable methods to protect adjacent spaces from damage during installation.

1. Maintain ambient temperatures in the area to receive terrazzo at not less than 60 deg. F.
2. Maintain adequate ventilation in the area to receive terrazzo.

C. Terrazzo Contractor shall protect other adjacent work from water and dust generated by grinding operations.

1.10 GUARANTEE

A. One year from date of substantial completion of terrazzo installation.

PART 2 - PRODUCTS

2.01 PERFORMANCE

A. Basis of Design: Barclay or approved equal.

B. Epoxy Resin:

1. Test Specimens: Mix resin materials according to manufacturer's recommendation without aggregate added and cure for 7 days at 75 degrees plus or minus 2 deg. F and 50 percent plus / minus 2 percent relative humidity.

2. Cured test specimens shall meet or exceed the following requirements:

a. Hardness: 60 to 85 per ASTM D 2240, Shore D.

b. Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a “C” die per ASTM D 412.

c. Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.

d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.

1) Distilled Water.

2) Mineral Water.

3) Isopropanol.

4) Ethanol.

5) Soap solution at 1 percent.

6) Sodium hydroxide at 10 percent solution.

7) Hydrochloric acid at 10 percent solution.

8) Hydrochloric acid at 30 percent solution.

9) Detergent Solution at 0.025.

10) Acetic Acid at 5 percent solution.

C. Epoxy Resin with Aggregate:

1. Test Specimens:

a. Mix epoxy resin according to manufacturer's recommendations and blend one volume of epoxy resin with 3 volumes of marble aggregate, consisting of

Barclay KR202295: Glass #0 30%, GA White #1 30%, MOP #1 40%

Barclay KR2022102: Glass #0 15%, Glass #1 15%, MOP #1 10%, Pure White #1 60%

b. Grind and grout with epoxy resin finished to a nominal 1/4 inch thickness.

c. Cure specimens 7 days at 75 deg. F plus / minus 2 deg. and 50 percent plus / minus 2 percent relative humidity.

2. Cured epoxy terrazzo specimens shall nominally meet the following requirements:

a. Flammability: Self- extinguishing, extent of burning 1/4 inch maximum according to ASTM D 635.

b. Coefficient of Linear Thermal Expansion: 0.000025 inch/inch per degree F per ASTM C531.

D. Bond Strength of Epoxy Terrazzo: 300 lb. failure according to field test method for surface soundness and adhesion as described in ACI Committee No. 403 Bulletin.

2.02 MATERIALS

A. Epoxy Resin Matrix: Two-component, high solids product complying with specified performance requirements.

1. Color: To be selected by architect from full range.

B. Primer: As recommended, manufactured and supplied by epoxy resin manufacturer.

C. Aggregates: Domestic marble chips.

1. Comply with NTMA gradation standards.
2. Abrasion and Impact Resistance: Loss of 40 percent or less when tested according to ASTM C 131 (LA Abrasion).
3. Aggregates shall contain no deleterious or foreign matter.

D. Divider Strips:

1. Material: Aluminum.
2. Strip Thickness: 1/8 inch.
3. Type: “L” strip: 3/8 inch by 1/8 inch.

2.03 MISCELLANEOUS ACCESSORIES

A. Sealer: Terrazzo Contractor shall provide a non-ambering, clear sealer that is chemically neutral; does not impair terrazzo aesthetics or physical properties; is recommended by terrazzo matrix manufacturer. Sealers shall comply with the following:

1. Comply with requirements of authorities having jurisdiction.
2. Water Based Sealer Properties: With pH factor between 7 and 10.

B. Moisture Mitigation: Two-component, high solids, moisture tolerant, high density, low odor, epoxy-based product produced by epoxy terrazzo resin manufacturer specifically recommended to reduce alkalinity levels and moisture emission to not more than 3 lbs/ per 1000 sq. ft per 24 hours.

C. Crack Suppression/Isolation Membrane: As recommended, produced and supplied by approved terrazzo resin formulator, having minimum 120 percent elongation potential per ASTM D 412. Include for 5% coverage of all epoxy terrazzo flooring areas.

2.04 MIXES

A. Terrazzo Selection: Terrazzo Contractor shall provide standard terrazzo mix(es) according to the following:

1. Custom Mix Color and Pattern: Match Architect's samples

B. Proportions for Epoxy Terrazzo Topping: Comply with resin supplier's recommendations.

C. Mixing of Terrazzo Topping: Mix epoxy components with aggregates in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The General Contractor and Architect shall examine substrates and areas, with Terrazzo Contractor present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

1. Slab Flatness Tolerance: Subfloor is not to vary more than 1/4 inch from true plane in a 10 foot span.
2. Cracks: Locate cracks and joints in concrete substrates. Verify location of control joints and expansion joints in epoxy terrazzo flooring.

a. If required to prevent cracks in concrete substrates transmitting through epoxy terrazzo flooring, the Terrazzo Contractor shall make a written recommendation to install a crack suppression membrane and include specific recommendations on type and location.

B. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to epoxy resin manufacturer's written instructions.

1. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

2. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.

3. If required to prevent moisture vapor transmission in concrete substrates, the Terrazzo Contractor shall make a written recommendation to install moisture mitigation materials and include specific recommendations on type and location.

C. The General Contractor shall be responsible for correcting non-conforming concrete substrates using materials compatible with epoxy terrazzo flooring system and as approved by the Terrazzo Contractor.

1. Materials used to correct nonconforming conditions must be compatible with the selected epoxy system and be approved by the manufacturer of epoxy resin materials and Terrazzo Contractor.

D. Terrazzo Contractor shall proceed with installation only after unsatisfactory conditions; including levelness tolerances, cracking, and excessive moisture vapor transmission have been corrected.

3.02 PREPARATION

A. General Contractor shall broom clean area to receive terrazzo to remove loose chips and all foreign matter.

B. Terrazzo Contractor shall mechanically abrade concrete surface.

C. Terrazzo Contractor shall provide moisture mitigation materials according to instructions and recommendations of moisture mitigation materials manufacturer. Cost for moisture mitigation materials and installation shall be included in the original bid submission.

D. Terrazzo Contractor shall provide flexible epoxy crack isolation/suppression membrane: Cost for materials and installation for installation over not more than five percent of the floor area receiving epoxy terrazzo shall be included in the Base Bid. Cost for additional materials and installation shall be an additional cost to the Owner or General Contractor under an approved Change Order.

3.03 POURED-IN-PLACE TERRAZZO INSTALLATION

A. Strip Materials: Terrazzo Contractor shall install strip materials as follows:

1. Divider and Control-Joint Strips:

    a. Locate divider strips in locations indicated.

    b. Install control joint strips back to back in locations indicated.

    c. Install strips in epoxy adhesive without voids below strips.

B. Placing Terrazzo:

1. Prime subfloor in accordance with manufacturer's recommendations.

2. Proportion and thoroughly blend the materials.

3. Place mixture to achieve specified thickness.

C. Finishing: Terrazzo Contractor shall finish the terrazzo topping as follows:

1. Rough Grinding:

   a. Grind with 24 or finer grit stones or with comparable diamond abrasives.

   b. Follow initial grind with 80 grit stones or with comparable diamond abrasives.

2. Grouting:

   a. Clean terrazzo with clean water and rinse. Allow to dry.

   b. Apply epoxy grout per manufacturer's instructions.

   c. Allow grout to cure.

3. Fine Grinding/Polishing: Grind with 150 grit stones or with comparable diamond abrasives until all grout is removed from surface. Final polish should be a 200 grit finish.

D. Terrazzo Cleaning: Terrazzo Contractor shall clean finished terrazzo as follows:

1. Remove grinding residue from terrazzo surface.

2. Wash terrazzo surfaces immediately after final grinding of terrazzo flooring with water and allow surfaces to dry thoroughly.

E. Sealing: Terrazzo Contractor shall seal terrazzo according to sealer manufacturer’s written instructions.

3.04 REPAIR

A. Terrazzo Contractor shall repair terrazzo areas that evidence lack of bond between topping and underbed according to NTMA’s written recommendations.

3.05 PROTECTION

A. After application of the sealer, the Work shall be ready for final inspection and acceptance by the Owner or his agent.

B. The General Contractor shall protect the finished floor after the Terrazzo Contractor has completed final grinding and applied sealer to terrazzo surfaces.

END OF SECTION

SECTION 09 68 13 – CARPET TILE

PART 1 – GENERAL INFORMATION

1.01 SECTION INCLUDES:

Manufacturers
Testing Protocols
Performance Requirements
Product Specifications
Warranties
Exclusions
Installation
Maintenance
Accessories

1.02 REFERENCES (INDUSTRY STANDARDS)

A. American Association of Textile Chemists and Colorists (AATCC):

1. AATCC 16 – Test Method for Colorfastness to Light
2. AATCC 107 – Test Method for Colorfastness to Water
3. AATCC 129 – Test Method for Colorfastness to Ozone in the Atmosphere under High Humidity.
4. AATCC 134 – Test Method for Electrostatic Propensity of Carpets.
5. AATCC 165 – Test Method for Colorfastness to Crocking: Carpets – AATCC Crock Meter Method
6. AATCC 175 – Test Method for stain Resistance: Pile Floor Coverings

B. American Society for Testing and Materials (ASTM):

1. ASTM D418 – Methods for Testing Pile Yarn Floor Covering Construction
2. (Finished Pile Thickness only)
3. ASTM E648 – Test Method for Critical Radiant Flux of Floor Covering Systems
4. ASTM E662 – Test Method for Specific Optical Density of Smoke

C. International Standards Organization (ISO):

1. ISO 2551 – Test Method for Dimensional Stability (Aachen Test)

D. Carpet and Rug Institute (CRI):

1. CRI Indoor Air Quality Testing and Labeling Program

1.03 ITEMS TO DELIVER

A. Provide the product's Technical Specifications data sheet as well as all installation and maintenance instructions.

B. When required, supply floor drawings and installation plans.

C. Supply a set of samples

1. Submit standard-size carpet tile samples of each type of carpet, in each specified pattern, color and construction.
2. Any alternates to specified products must be submitted for approval by a representative of the end user or architect/design firm at least ten (10) working days prior to bid or proposal.
    a. Submit two (2) sets of samples for each carpet type.
    b. No carpet shipments are permitted until acceptance of final samples is given by representative of the end user or architect/design firm, certifying that samples are the approved color, pattern and texture.
3. Custom Color only
    a. A representative of the end user or architect/design firm, certifying that the samples are the approved color, pattern, and texture, shall sign high quality color samples.
    b. Samples submitted are assumed to be the manufacturer's best obtainable match to the color described under Materials Section.
    c. Must have federally registered Branded trademark.

D. When required, provide Mohawk Group's attestation, certified by an independent laboratory, confirming that the flooring complies with the fire standards of the following tests:

1.	Radiant Panel: ASTM E648:	>.45 watts/sq. cm: Class 1
2.	Smoke Density: ASTM E662:	450 Flaming Mode - Maximum
3.	Static Generation: AATCC 134:	3.5 KV - Maximum
4.	Lightfastness: AATCC 16E:	Min 4.0 at 40 hrs.
5.	Crocking: AATCC 165:	4.0 – Wet/Dry
6.	Cold Water Bleed: AATCC 107:	3.0 - Minimum
7.	Ozone Fade: AATCC 129:	3.0 - Minimum
8.	Soil Protection: AATCC 189:	500 PPM Min.
9.	CRI Green Label Plus Air Quality Certification:	Pass
10.	CRI Appearance Retention Rating	3.0 minimum – Heavy Traffic 3.5 minimum – Severe Traffic
11.	Aachen Test: ISO 2551	Less than .15% shrinkage or growth

12. Stain protection: AATCC 175: Equal to or greater than 8.0 on Red 40 stain test with 100 revolutions of the Taber Abrader (1,000 gram weight per H-18 wheel) then stain test in the abraded area.

Special Performance Requirements

1. Must have Soil and Stain Resist treatment
2. Fiber must have modified delta cross-section w/hollow core
3. Must be at least 24 dpf fiber
4. Must pass GSA requirements for permanent stain resistant carpet
5. Backing must pass British Spill Test and 10,000 Impact Test

E. Provide manufacturer's lifetime warranties for:

1. Wear
2. Static
3. Edge Ravel
4. Zippering
5. Delamination
6. Dimensional Stability
7. Supplemental Fiber Warranties:
    a. Lifetime Stain Warranty
    b. Lifetime Warranty against color transfer wet or dry
    c. Lifetime Warranty against wet fastness
    d. 10 Year Colorfastness to Light

e. 10 Year Colorfastness to Atmospheric contaminants

1.04 QUALITY ASSURANCE

A. Have Mohawk Group flooring installed by an installer qualified in the installation of specified flooring.

B. In accordance with the technical instructions in the installation instructions, use all accessories recommended by Mohawk Group when installing its flooring.

C. Follow the instructions specified in the most recent version of Mohawk Group's installation instructions.

D. Corporate Social Responsibility
Corporate social responsibility requirements: Manufacturer shall meet the corporate social responsibility as outlined below.

1. GRI Reporting: Manufacturer to have a corporate sustainability report (CSR) as per the GRI G4 guidelines.
2. Health and Wellness: Manufacturer to have on-site health clinics and biometric screenings, or health facilities displaying commitment towards health and wellness.
3. United Nations Sustainable Development Goals (UN SDGs):
Manufacturer must identify and commit to at least part of the UN SDGs as applicable to their organization and industry.
   a. Facility certifications: Product's manufacturing facility shall be ISO 9001 certified. Manufacturer to have at least one green building certification for their own facilities – LEED, Living Building Challenge or WELL Building Standard.

1.05 DELIVERY, HANDLING, STORAGE

A. Deliver the flooring to the installation site in Mohawk Group's original packaging. Indicate the project name and handling instructions on the outside of the boxes.

B. Advise the carrier of any damaged material and indicate it on the packing slip.

C. Store the flooring inside, sheltered from extreme hot or cold temperatures. Place the material on a smooth level floor or where there is uniform solid support in a clean, dry well-ventilated area. Unstack the pallets. The long-term storage temperature must be maintained between 65°F (18°C) and 85°F (29°C). Protect adhesive and flooring material from freezing, extreme heat and direct sun exposure.

D. Acclimatize the subfloor, all flooring material and adhesive for 48 hours before, during and after the installation by maintaining the room temperature between 65°F (18°C) and 85°F (29°C). The pallets should be unstacked 24 hours prior to use.

E. Afterwards, maintain the room temperature between 65°F (18°C) and 85°F (29°C). Protect the material from direct sources of heat such as air vents and other types of heaters.

F. Install the flooring after all other finishing work, including painting, have been completed.

PART 2 - PRODUCTS

2.01 MANUFACTURER

Mohawk Group, 160 S. Industrial Blvd, Calhoun GA 30701 Telephone 800.241.4494. Website: www.mohawkgroup.com
Contact: Vickie Small
vickie_small@mohawkind.com
504-432-3182

2.02 CARPET TILE CONSTRUCTION

A. Characteristics

Style Name:	**Urban Field II GT446**
Collection:	Nutopia 2
Product Type:	Carpet Tile

Construction:	Tufted
Surface Texture:	Textured Patterned Loop
Gauge:	1/12” (47.00 rows per 10 cm)
Density:	8280
Stitches per Inch:	28.5 (112.2 per 10 cm)
Finished Pile Thickness:	.100” (2.54 mm)
Dye Method:	Solution Dyed
Backing Material:	EcoFlex NXT
Fiber Type:	Duracolor® Tricor Premium Nylon
Face Weight:	24.00 oz per sq. yd. (814 g/m2)
Size:	12” x 36”
Soil Release Technology:	EcoSentry Soil Protection
Installation Method:	Basket Weave, Brick Ashlar, Half Lap, Herringbone, Plank Half Lap,
Indoor Air Quality:	CRI Green Label Plus GLP 1171
Foot Traffic Recommendation TARR:	Severe
NSF 140	EcoFlex NXT - NSF 140 Gold

Style Name:	**Urban Fringe II GT445**
Collection:	Nutopia 2
Product Type:	Carpet Tile
Construction:	Tufted
Surface Texture:	Textured Patterned Loop
Gauge:	1/12” (47.00 rows per 10 cm)
Density:	7527
Stitches per Inch:	31.5 (124.02 per 10 cm)
Finished Pile Thickness:	.117” (2.97 mm)
Dye Method:	Solution Dyed
Backing Material:	EcoFlex NXT
Fiber Type:	Duracolor® Tricor Premium Nylon
Face Weight:	23.00 oz per sq. yd. (780 g/m2)
Size:	12” x 36”
Soil Release Technology:	EcoSentry Soil Protection
Installation Method:	Basket Weave, Brick Ashlar, Half Lap, Herringbone, Plank Half Lap,
Indoor Air Quality:	CRI Green Label Plus GLP 1171
Foot Traffic Recommendation TARR:	Severe
NSF 140	EcoFlex NXT - NSF 140 Gold

Style Name:	**Urban Passage II GT444**
Collection:	Nutopia 2
Product Type:	Carpet Tile
Construction:	Tufted
Surface Texture:	Textured Patterned Loop
Gauge:	1/12” (47.00 rows per 10 cm)
Density:	8280
Stitches per Inch:	30 (118.11 per 10 cm)
Finished Pile Thickness:	.120” (3.05 mm)
Dye Method:	Solution Dyed
Backing Material:	EcoFlex NXT
Fiber Type:	Duracolor® Tricor Premium Nylon
Face Weight:	23.00 oz per sq. yd. (780 g/m2)
Size:	12” x 36”
Soil Release Technology:	EcoSentry Soil Protection
Installation Method:	Basket Weave, Brick Ashlar, Half Lap, Herringbone, Plank Half Lap,

Indoor Air Quality:	CRI Green Label Plus GLP 1171
Foot Traffic Recommendation TARR:	Severe
NSF 140	EcoFlex NXT - NSF 140 Gold

Refer to the product's Technical Specifications data sheet for detailed specifications.

Choose from any of Mohawk Group's complete line of colors (indicate the item number).

This product was manufactured in a factory that has ISO 9001 and ISO 14001 certifications.

Made in the United States.

All specifications are subject to normal manufacturing tolerances

2.03 ADHESIVE

Mohawk Group requires the use of the following adhesives to maintain the product warranty:

EnPress Adhesive (up to 95% in-situ RH and a pH of 12.0)

FlexLok Tabs (No moisture testing is required, provided no signs of visual moisture is present and existing adhesive has been reduced to a minimal residue.)

2.04 OTHER MATERIAL

A. Subfloor repairs: use a good-quality Portland cement-based compound modified with latex that has a minimal resistance to compression of 3500 lbs/sq. in. (246 kg/cm^2). to fill, smooth or level subfloor imperfections.
B. Self-levelling underlayment: use a Portland cement-based self-levelling underlayment modified with a polymer that has a minimal resistance to compression of 3500 lbs/sq. in. (246 kg/cm^2).

PART 3 – EXECUTION

3.01 SITE INSPECTION

A. Examine the subfloor before installation to ensure that the surface is clean, dry, smooth, structurally sound and free from foreign substances that may adversely affect adhesion or cause discoloration. Furthermore, ensure that the subfloor is free of paint, varnish, adhesive, oil, grease, solvent and other foreign substances, including treatment compounds, sealers and curing compounds that may adversely affect adhesion or alter the appearance or durability the carpet tile.

B. Verify the surface to ensure there is no powder, scaling or mold. If there is, remove it with a mechanical sander and level with a good-quality cement-based Portland primer.

C. Slabs that have been either using a curing agent or a sealer will have to be treated to ensure that the adhesion has not been impaired.

D. Do not install on cement slabs that have been subjected to adhesive chemical abatement, unless an approved remediation system was used afterwards.

E. Report and rectify all unsatisfactory conditions. Do not start flooring installation until all rectifications have been completed.

3.02 SUBFLOOR PREPARATION

A. Level all rough surfaces and fill cracks and marks with a Portland cement-based patching compound modified with latex.

B. Mechanically remove all surface contaminants such as paint, oil, grease, varnish, adhesive as well as various other products such as treatment compounds.

C. Measure the humidity and pH levels (in situations where pH testing is required) in compliance with the following standards before installation:

1. ASTM F 2170, Relative Humidity (RH) test using in situ probes.
2. ASTM F 710, pH levels (test procedure 5.3.1).
3. The ASTM test frequency recommendation is 3 measures for the first 1,000 sq. ft. (92.9 sq. m) and one measure for each additional 1,000 sq. ft. (92.9 sq. m).

D. Ensure Moisture, Relative Humidity and pH tests have all been conducted and measurements meet manufacturer's recommendations.

E. In case of doubt, test the adhesion on the cement subfloor or other surface that will be covered by the flooring. Do the test using the specified flooring and recommended adhesive.

3.03 CARPET TILE FLOORING INSTALLATION

A. Install the flooring according to the latest version of Mohawk Group's installation instructions. Use the tools, adhesives, trowel types and procedures recommended in the instructions.

B. Acclimatize the subfloor, all flooring material and adhesive for 48 hours before, during and after the installation by maintaining the room temperature between 65°F (18°C) and 85°F (29°C). Afterwards, maintain the temperature between 65°F (18°C) and 85°F (29°C).

3.04 CLEANING AND PROTECTION

A. Remove all excess adhesive immediately after installation as recommended in Mohawk Group's installation instructions.

B. Before allowing traffic after installation, consult and follow the recommendations in Mohawk Group's installation instructions.

C. Following installation and cleanup, if the work of all other trades has not yet been completed, protect the flooring by laying sheets of non-staining brown Kraft paper, and then a layer of plywood sheets (rolls of non-staining heavy cardboard material could also be used for protection).

D. Follow the instructions in Mohawk Group's Maintenance Instructions when performing initial and regular maintenance procedures.

Please note that technical website documents prevail.

3.05 CARPET RECLAMATION – BROADLOOM CARPETING AND CARPET TILE

This specification is for carpet reclamation and is designed to manage carpet recycling for any type of used carpet or carpet pad.

A. CARPET REMOVAL – BROADLOOM

1. Remove used carpet in carpet pieces, roll tightly, and pack neatly in container. (Include carpet scrap and waste from new installation.) Immediately remove used carpet from Site. For reclamation projects coordinated by Mohawk Reclamation Department, place in Mohawk provided covered containers.
2. Deposit only clean, dry used carpets in containers. Clean shall be defined as carpet free from demotion debris or asbestos contamination, garbage, and tack strips.

B. CARPET REMOVAL – CARPET TILE

1. Remove used carpet tile and stack neatly on pallets. Neatly stack carpet tiles or repack in cardboard boxes prior to placing in container. Do not stack higher than 6 feet on pallets. (Include carpet scrap

and waste from new installation.) Immediately remove used carpet from Site. For reclamation projects coordinated by Mohawk Reclamation Department, place in Mohawk provided covered containers.

2. Deposit only clean, dry used carpets in containers. Clean shall be defined as carpet free from demotion debris or asbestos contamination, garbage, and tack strips.

C. CONTAINER HANDLING

1. Place used carpet in container supplied by Mohawk Reclamation Department. Containers are fully enclosed and shall be kept locked or supervised.
2. Broadloom carpet must be segregated in separate containers from tile carpeting.
3. Use effective packing techniques to maximize the amount of material in the container. On average the following amounts are the related container capacities.

Container Size	Broadloom Capacity	Tile Capacity
53’ Foot	4,800	3,500

D. CONTAINER REMOVAL

When container is full, contact Mohawk Reclamation Department to coordinate pickup and drop-off of replacement container if needed. If container is locked for security purposes, remove the lock prior to pick up.

The Mohawk Reclamation Department toll free number is (877) 3RE-CYCL or (877) 373-2925

E. RECLAMATION CERTIFICATE

The Mohawk Reclamation Department will issue a reclamation certificate once used carpet is removed from the job site and or dealer location and delivered to reclamation facility.

END OF SECTION

SECTION 09 83 19 – ACOUSTICAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:
   1. Acoustical wall panels and installation components.

B. Related Sections:
   1. Section 09 21 16 –Gypsum Board Assemblies
   2. Division 26 Sections - Electrical Work

C. Alternates
   1. Prior Approval: Refer to Division 01 for product substitution procedures.
   2. Submittals which do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Panel design, size, composition, color, and finish; installation system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

A. Test Methods:
   1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. ASTM E 84/CAN/ULC S102 Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. CAN/ULC S102 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical wall panel required.

B. Samples: Minimum 3 inch x 3 inch samples of specified acoustical wall substrate; minimum 4 inch long samples of attachment method including trim and decorative accents.

C. Shop Drawings: Submit shop drawings showing how panels are to be laid out on the walls, details of trim members and width of panels. Width of panels and location of vertical seams are critical.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and installation components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical wall components with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristics: As follows, tested per ASTM E 84,
      a. Flame Spread: 25 or less
      b. Smoke Developed: 200 or less

C. Coordination of Work: Coordinate acoustical wall work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical wall panels to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
B. Before installing acoustical wall panels, permit them to reach room temperature and a stabilized moisture content.
C. Handle acoustical wall panels carefully to avoid chipping edges or damaged units in any way.

1.7 PROJECT CONDITIONS

A. Space Enclosure:
   1. Soundsoak Fiberglass Panels: All wet work must be complete and dry prior to installation. Installation shall be carried out where the temperature is between 40 degrees F and 120 degrees F. These temperature conditions must be maintained throughout the life of the warranty.

1.8 WARRANTY

A. Acoustical Wall Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
   1. Acoustical Wall Panels: Manufacturer’s defects

B. Warranty Period:
   1. Acoustical wall panels: One (1) year from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Acoustical Wall Panels: Furnish quantity of full-size units equal to 5.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acoustical Wall Panels:
   1. Armstrong World Industries, Inc. – Basis of Design
      a. Soundsoak 60

2.2 ACOUSTICAL WALL PANELS

A. Acoustical Wall Panels: Type AWP-1:
   1. Surface Texture: Fabric
   2. Composition: Fiberglass with resin-hardened edges. Impact-resistant panels available.
   3. Fabric Finish:
      a. Standard - Lido, color as selected from manufacturer's standard offering.
   4. Thickness: ¾"
   5. Width: Up to 4 feet
   6. Panel Heights: Up to 10 feet
   7. Edge Profile:
      a. Standard - Fabric wrapped sqyare edges on two long panel sides.
      b. Fabric wrapped on all four sides.
      c. Kerfed on two long sides for installation with internal H splines.
   8. Noise Reduction Coefficient (NRC): ASTM C 423; A Mounting: 1 inch (0.80); 2 inch (1.05).
   9. Flame Spread: ASTM E84; with FR-701 Fabrics - composite Class A rating.
   10. Dimensional Stability: Standard – space must be enclosed with HVAC systems operating at all times.
   11. Acceptable Product: Soundsoak, as manufactured by Armstrong World Industries.

B. Acoustical Wall Panel Accessories:
   1. H spline kerf.
   2. J-molding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Measure each wall area and establish layout of acoustical units to balance border widths at opposite edges of each wall. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Install wall panels by attaching the panels to an existing wall per the manufacturer's instructions, LA-297301, and in accordance with the authorities having jurisdiction.

B. For installation instructions with internal H spline, refer to installation instructions for standard Soundsoak, LA-295818.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Routine maintenance of Soundsoak wall panels should consist of frequent vacuuming to minimize dirt accumulation. A dry or wet shampoo can be used on Soundsoak fabric. Work in with a damp sponge and vacuum to remove residue.

END OF SECTION

SECTION 09 84 00 – ACOUSTIC SOUNDPROOFING MEMBRANE

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:
   1. Acoustic soundproofing membrane.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including supplements and addendums.
B. Applicable Specification Sections: Division 01 – General and Division 09 – Finishes.

1.3 REFERENCES

A. International Building Code (IBC) 2012:
   1. Section 1207 – *Sound Transmission*
B. ASTM Tests:
   1. E90 – *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.*
   2. E413 – *Classification for Rating Sound Insulation.*
C. ASTM Specifications:
   1. C840 – *Standard Specification for Application and Finishing of Gypsum Board.*

1.4 SUBMITTALS

A. For each product indicated:
   1. Product Data Sheet: manufacturer's specifications including laboratory test summary.
   2. Installation Instructions: detailed installation procedure including jobsite condition requirements, surface preparation requirements, and approved products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered in original unopened packaging.
B. The acoustic soundproofing membrane may be stored in a wet or dry environment and may be stored outdoors for up to three months on construction sites without special tarps or covering.
   1. If stored below freezing temperatures, material may require up to 48 hours of acclimation to regain pliability.
   2. Acclimate the acoustic soundproofing membrane for a minimum of 24 hours at temperatures 60 degrees (F) or greater to reduce material stiffness when handling.
   3. If material stiffens, it may be softened more rapidly using a heat gun.

1.6 PROJECT CONDITIONS

A. The acoustic soundproofing membrane is typically installed after framing, insulation, and electrical are complete. Insulation should be installed in the wall cavity in addition for optimal performance.
B. Ensure that all applicable inspections are completed prior to installation of the acoustic soundproofing membrane.
C. The acoustic soundproofing membrane may be installed prior to "drying in" the building (prior to installation of windows and doors).
   1. Drywall should be installed within 2-4 weeks of the acoustic soundproofing membrane to prevent excessive wear.
      a. For longer delays, washers should be installed for securely fasten the material.
   2. Drywall installation permanently attaches the acoustic soundproofing membrane to the stud.

PART 2 – PRODUCTS

2.1 ACOUSTIC SOUNDPROOFING MEMBRANE

A. Manufacturer: Subject to compliance with requirements, provide products by the following:
   a. Basis of Design : Wall Blokker by Commercial Acoustics
   b. Or approved equal

B. Materials:
   1. Engineered sound reduction membrane.
   2. Flexible Ethylene Vinyl Acetate (EVA) product made from post-industrial recycled material.

C. Dimensions:
   1. Thickness: 1/8”
   2. Weight: 1 lb/sq.ft.
   3. Standard Sizes: 4’x25’ rolls; 4’x10’ and 4’x8’ sheets; custom length rolls available.
   4. Tolerances:
      a. Width: +/- 0.5”
      b. Length: +/- 1%
      c. Nominal Thickness: +/- 0.10”

D. Performance:
   1. Minimum STC = 25 (ASTM E90).
   2. UL Classified Assemblies:
      a. 300, 400, 500 Series
   3. Flammability Rating:
      a. Class 1 (ASTM E84 Rev. A)
      b. 1-Hour fire resistance wall rating (ASTM E119)
      c. 0.3 Thermal Resistance coefficient (ASTM C518)
   4. Environmental:
      a. Mold/Mildew resistant. No fungal/algae growth and no visible disfigurement (ASTM D3273 & ASTM G21).
      b. Impermeable air and moisture barrier.
      c. Non-PVC: no off-gassing.
      d. HIPPA Compliant.
      e. 100% recyclable at end of life.

PART 3 – EXECUTION

3.1 PREPARATION

A. Wall and/or stud assembly to receive the acoustic soundproofing membrane must be structurally sound prior to installation.

B. Wall must be clean and free of debris.
   1. Protrusions greater than 1/16” shall be scraped from the surface to avoid puncturing.

C. See Section 1.6 for additional project condition requirements.

3.2 INSTALLATION

A. Starting in one corner of the room, install the acoustic soundproofing membrane flush with the top of the top plate, and hang it vertically.

B. <u>Metal Studs:</u>
   1. Attach the acoustic soundproofing membrane directly to the light gauge metal studs using drywall screws.
   2. Fasten every 12” horizontally along the top.
      a. The acoustic soundproofing membrane installed on walls greater than 15’ in height shall be secured with washers along the top to prevent the fasteners from tearing the material.

b. Fasteners shall be used on intermediate studs (in addition to exterior studs) every 12' vertically.

3. Straighten the acoustic soundproofing membrane from the top down so that it is flush against the studs.
4. Attach the acoustic soundproofing membrane to the center of each vertical stud using drywall screws.
5. Fasten every 36" vertically along the center of each stud.

3.3 PROCEDURE

A. Install the acoustic soundproofing membrane as indicated.
B. Keep fasteners as flush as possible to prevent protrusion into the finished wallboard.
   1. Fasteners shall not protrude more than 1/16" from the acoustic soundproofing membrane surface.
C. Do NOT overlap the seams of separate sheets.
   1. Tightly butt the side of the next sheet of the acoustic soundproofing membrane to the edge of the existing attached sheet.
D. For seams that do not fall on a stud, tape with "Seam-Seal" or equivalent.
   1. If seams fall on the stud with gaps greater than 1/8", then taping is also required.
   2. Ensure that there are no bubbles or wrinkles in the tape. Commercial tape alternatives include commercial duct tape.
   3. The tape is semi-permanent and will be permanently sealed in position when drywall is installed. Drywall installation will seal the acoustic soundproofing membrane against the existing studs.
E. Cut the acoustic soundproofing membrane to fit around irregular objects and penetrations including outlets, switches, and junction boxes.
   1. Gaps shall be less than 1/8".
   2. Gaps greater than 1/8" shall be sealed with acoustical or non-hardening caulk.
   3. Gaps greater than 1/4" may be filled with backer rod or fiber batting.
   4. Putty pads should be installed on the back of all electrical boxes.
F. Caulk the bottom of the floor plate at the floor line with acoustical sealant.
G. Install drywall per normal technique (ASTM C840).
   1. The acoustic soundproofing membrane will be fastened permanently when the gypsum board is installed.

END OF SECTION

SECTION 09 84 33 – ACOUSTICAL CEILING BAFFLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical ceiling baffles for suspended ceiling applications.

B. Products:

1. BLADE BAFL Acoustical Ceiling Baffle by Fräsch, or approved equal meeting all material, fire, and acoustic performance criteria.

C. Baffles shall be sized, spaced, and oriented to achieve maximum acoustic performance as indicated on drawings or per manufacturer's recommendations.

1.3 REFERENCES

A. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building MaterialsB. ASTM C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets including:

1. Acoustic performance (NRC values).
2. Fire rating.
3. Material content and sustainability attributes.
4. Manufacturer and product specifications.
   B. Shop Drawings: Indicate layout, spacing, suspension details, and installation methods.
   C. Samples: Minimum 12 x 12 inch sample showing material, thickness, color, and finish.
   D. Warranty: Manufacturer's warranty documentation.
   E. Substitution Requests: For approved equal products, submit data demonstrating equivalency to BLADE BAFL at least 10 days prior to bid, including:
5. Product data
6. Acoustic and fire test reports
7. Sample panels

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain acoustical ceiling baffles from a single manufacturer or approved equal meeting all performance requirements.

B. Fire Performance: Class A surface burning characteristics per ASTM E84.

C. Acoustic Performance: NRC and absorption coefficients must meet or exceed the specified BLADE BAFL values.

D. Dimensional Requirements: Baffles must maintain manufacturer-recommended width, height, and spacing to achieve maximum acoustic performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packaging.

B. Store materials flat, in a dry area, and protected from damage.

1.7 WARRANTY

A. Manufacturer's Warranty: 2 years covering defects in material and workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Fräsch, 682.200.3005, www.frasch.com – BLADE BAFL

B. Approved Equal: Products from other manufacturers meeting all material, fire, and acoustic performance criteria may be considered upon submission and approval by the Architect.

2.2 ACOUSTICAL CEILING BAFFLES

A. Product: BLADE BAFL Acoustical Ceiling Baffle

B. Material: 9 mm thick, 100% PET felt with minimum 55% post-consumer recycled content

1. Low VOC
2. 100% recyclable

C. Fire Rating: Class A per ASTM E84 (based on 9 mm white)

D. Acoustic Performance (per ASTM C423):

Frequency	NRC	Absorption (Sabins/m²)
250 Hz	0.57	4.45
500 Hz	0.90	7.05
1000 Hz	1.36	10.62
2000 Hz	1.61	12.61

Overall NRC: 1.10

E. Dimensional and Spacing Requirements:

1. Width, height, and spacing must comply with manufacturer's guidelines for maximum acoustic performance.

2. Adjust layout for room geometry as indicated on reflected ceiling plans.

2.3 HARDWARE

A. Standard Suspension:

1. Aircraft Cable / Threaded Rod
2. Flat Bracket
3. Grip Lock

B. Optional Unistrut Suspension:

1. Aircraft Cable / Threaded Rod
2. Flat Bracket
3. Grip Lock
4. Coupler Nut
5. Nylon Cone Nut

C. Drop Ceiling Suspension:

1. Aircraft Cable / Threaded Rod
2. Flat Bracket
3. Grip Lock
4. Coupler Nut
5. T-Grid Caddy Clip

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify substrates and structural supports are acceptable for installation of acoustical ceiling baffles.

B. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Assemble PET panels with suspension hardware with minimal field modifications.

C. Adjust mounting point positions as required for alignment, design intent, and to maintain maximum acoustic performance.

3.3 CLEANING

A. Clean exposed surfaces with a clean, damp cloth after installation.

B. Remove and replace products that cannot be cleaned to the satisfaction of the Architect.

3.4 PROTECTION

A. Protect installed products from damage until Substantial Completion.

SECTION 09 91 23 - INTERIOR,AND EXTERIOR PAINTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior paint and coating systems including surface preparation.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 04 20 00 - Unit Masonry: Concrete Masonry Units (CMU) and brick.

C. Section 05 12 16 - Fabricated Fireproofed Steel Columns.

D. Section 05 50 00 - Metal Fabrications.

E. Section 06 20 00 - Finish Carpentry.

F. Section 06 40 00 - Architectural Woodwork.

G. Section 08 11 13.16 - Custom Hollow Metal Doors and Frames.

H. Section 09 21 16.23 - Gypsum Board Shaft Wall Assemblies.

I. Section 23 05 00 - Common Work Results for HVAC.

J. Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCES

A. Steel Structures Painting Council (SSPC):
   1. SSPC-SP 1 - Solvent Cleaning.
   2. SSPC-SP 2 - Hand Tool Cleaning.
   3. SSPC-SP 3 - Power Tool Cleaning.
   4. SSPC-SP5/NACE No. 1, White Metal Blast Cleaning.
   5. SSPC-SP6/NACE No. 3, Commercial Blast Cleaning.
   6. SSPC-SP7/NACE No. 4, Brush-Off Blast Cleaning.
   7. SSPC-SP10/NACE No. 2, Near-White Blast Cleaning.
   8. SSPC-SP11, Power Tool Cleaning to Bare Metal.
   9. SSPC-SP12/NACE No. 5, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating.
   10. SSPC-SP 13 / NACE No. 6 Surface Preparation for Concrete.

B. Material Safety Data Sheets / Environmental Data Sheets: Per manufacturer's MSDS/EDS for specific VOCs (calculated per 40 CFR 59.406). VOCs may vary by base and sheen.

C. California Department of Public Health (CDPH):
   1. CDPH v1.1-2010 and V1.2-2017

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: For each paint system indicated, including.
   1. Product characteristics.
   2. Surface preparation instructions and recommendations.
   3. Primer requirements and finish specification.
   4. Storage and handling requirements and recommendations.
   5. Application methods.
   6. Cautions for storage, handling and installation.

C. Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer's products, colors, and sheens available.

D. Verification Samples: For each finished product specified, submit samples that represent the actual product, color, and sheen.

E. Coating Maintenance Manual: Upon conclusion of project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams, "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

F. Only submit complying products based on project requirements (i.e. LEED). One must also comply with the regulations regarding VOCs (CARB, OTC, SCAQMD, LADCO). To ensure compliance with district regulations and other rules, businesses that perform coating activities should contact the local district in each area where the coating will be used.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Paint exposed surfaces. If a color of finish, or a surface is not specifically mentioned, Architect will select from standard products, colors, and sheens available.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless indicated.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish surfaces for verification of products, colors, and sheens.
   2. Finish area designated by Architect.
   3. Provide samples that designate primer and finish coats.
   4. Compatibility and Adhesion: Check after one week of drying and curing by testing in accordance with ASTM D3359; Adhesion by tape test. If the coating system is incompatible, additional surface preparation up to and including complete removal may be required.
   5. Do not proceed with remaining work until the Architect approves the mock-up.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information.
   1. Product name, and type (description).

2. Application and use instructions.
3. Surface preparation.
4. VOC content.
5. Environmental handling.
6. Batch date.
7. Color number.

B. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

C. Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

D. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and, in the quantities, described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

B. Furnish Owner with an additional one percent of each material and color, but not less than 1 gal (3.8 l) or 1 case, as appropriate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Sherwin-Williams, which is located at: 101 Prospect Ave.; Cleveland, OH 44115; ASD Toll Free Tel: 800-524-5979; Tel: 216-566-2000; Fax: 440-826-1989; Email: request infospecifications@sherwin.com; Web:www.swspecs.com.
   a. Contact: Shane Crawford – Architectural Account Executive.; shane.a.crawford1@sherwin.com, Phone: 479-601-2982.

B. Requests for substitutions will be considered in accordance with the provisions of Section 01 60 00 - Product Requirements.

2.2 APPLICATIONS/SCOPE

A. Interior Paint and Coating Systems:
   1. Metal: Structural steel, joists, trusses, beams, partitions, and similar items.
   2. Drywall: Drywall board, Gypsum board.

2.3 PAINT MATERIALS - GENERAL

A. Paints and Coatings:
   1. Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color. Or follow manufactures product instructions for optimal color conformance.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use a primer categorized as "best" by the manufacturer.

C. Coating Application Accessories: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer's specifications.

D. Color: Refer to Finish Schedule for paint colors, and as selected.

2.4 INTERIOR PAINT AND COATING SYSTEMS

A. Metal: Access Metal Panels, Diffusers, Hollow Metal Door Frames and similar items..
1. Latex Systems:
a. Semi-Gloss Finish High Performance:
1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils. wet, 2.0 mils. dry per coat).
2) 2nd Coat: S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series.
3) 3rd Coat: S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series (2.0-4.0 mils. dry per coat).
b. Eg-Shel / Satin Finish High Performance:
1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils. wet, 2.0 mils. dry per coat).
2) 2nd Coat: S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series.
3) 3rd Coat: S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series (2.0-4.0 mils. dry per coat).

B. Drywall: Walls, Ceilings, Gypsum Board, and similar items.
1. Latex Systems:
a. Semi-Gloss Finish Scuff Resistant Waterbased Enamel:
1) 1st Coat: S-W ProMar200 Zero VOC Interior Latex Primer, B28W2600 (4 mils. wet, 1.5 mils. dry per coat).
2) 2nd Coat: Sherwin-Williams Scuff Tuff Int. Waterbased Enamel, Semi-Gloss, S26-150 Series.
3) 3rd Coat: Sherwin-Williams Scuff Tuff Int. Waterbased Enamel, Semi-Gloss, S26-150 Series (4 mils. wet, 1.2 mils. dry per coat).
b. Eg-Shel Finish Scuff Resistant Waterbase Enamel:
1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600 (4 mils. wet, 1.5 mils. dry per coat).
2) 2nd Coat: Sherwin-Williams Scuff Tuff Int. Waterbased Enamel, Eg-Shel, S24-150 Series.
3) 3rd Coat: Sherwin-Williams Scuff Tuff Int. Waterbased Enamel, Eg-Shel, S24-150 Series (4 mils. wet, 1.2 mils. dry per coat).

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until the substrates have been properly prepared; notify Architect of unsatisfactory conditions before proceeding. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

B. Proceed with work only after conditions have been corrected and approved by all parties,

otherwise application of coatings will be considered as an acceptance of surface conditions.

C. Previously Painted Surfaces: Verify that existing painted surfaces do not contain lead based paints, notify Architect immediately if lead based paints are encountered.

3.2 SURFACE PREPARATION

A. General: Surfaces shall be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint, or other contamination to ensure good adhesion.
   1. Prior to attempting to remove mildew, it is recommended to test any cleaner on a small, inconspicuous area prior to use. Bleach and bleaching type cleaners may damage or discolor existing paint films. Bleach alternative cleaning solutions are advised.
   2. Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply solution and scrub the mildewed area. Allow solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.
   3. Remove items including but not limited to thermostats, electrical outlets, switch covers and similar items prior to painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
   4. No exterior painting should be done immediately after a rain, during foggy weather, when rain is predicted, or when the temperature is below 50 degrees F (10 degrees C), unless products are designed specifically for these conditions. On large expanses of metal siding, the air, surface, and material temperatures must be 50 degrees F (10 degrees F) or higher to use low temperature products.

B. Aluminum: Remove all oil, grease, dirt, oxide, and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.

C. Block (Cinder and Concrete): Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners. Concrete and mortar must be cured at least 30 days at 75 degrees F (24 degrees C). The pH of the surface should be between 6 and 9 unless the products are designed to be used in high pH environments. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface. Fill bug holes, air pockets, and other voids with a cement patching compound.

D. Concrete, SSPC-SP13 or NACE 6: This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls, and shotcrete surfaces. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

E. Cement Composition Siding/Panels: Remove all surface contamination by washing with an appropriate cleaner, rinse thoroughly and allow to dry. Existing peeled or checked paint should be scraped and sanded to a sound surface. Pressure clean, if needed, with a minimum of 2100 psi pressure to remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defective coatings. Allow the surface to dry thoroughly. The pH of the surface should be between 6 and 9 unless the products are designed to be used in high pH environments.

F. Copper and Stainless Steel: Remove all oil, grease, dirt, oxide, and other foreign material by cleaning per SSPC-SP 2, Hand Tool Cleaning.

G. Exterior Composition Board (Hardboard): Some composition boards may exude a waxy material that must be removed with a solvent prior to coating. Whether factory primed or unprimed, exterior composition board siding (hardboard) must be cleaned thoroughly and primed with an alkyd primer.

H. Drywall - Exterior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth, and all dust removed prior to painting. Exterior surfaces must be spackled with exterior grade compounds.

I. Drywall - Interior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth, and all dust removed prior to painting.

J. Galvanized Metal: Clean per SSPC-SP1 using detergent and water or a degreasing cleaner to remove greases and oils. Apply to a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP16 is necessary to remove these treatments.

K. Plaster: Must be allowed to dry thoroughly for at least 30 days before painting unless the products are designed to be used in high pH environments. Room must be ventilated while drying; in cold, damp weather, rooms must be heated. Damaged areas must be repaired with appropriate patching material. Bare plaster must be cured and hard. Textured, soft, porous, or powdery plaster should be treated with a solution of 1 pint household vinegar to 1 gallon of water. Repeat until the surface is hard, rinse with clear water and allow to dry.

L. Steel: Structural, Plate, And Similar Items: Should be cleaned by one or more of the surface preparations described below. These methods are used throughout the world for describing methods for cleaning structural steel. Visual standards are available through the Society of Protective Coatings. A brief description of these standards together with numbers by which they can be specified follow.
   1. Solvent Cleaning, SSPC-SP1: Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation.
   2. Hand Tool Cleaning, SSPC-SP2: Hand Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Beforehand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.
   3. Power Tool Cleaning, SSPC-SP3: Power Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.
   4. White Metal Blast Cleaning, SSPC-SP5 or NACE 1: A White Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
   5. Commercial Blast Cleaning, SSPC-SP6 or NACE 3: A Commercial Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt,

dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 33 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.

6. Brush-Off Blast Cleaning, SSPC-SP7 or NACE 4: A Brush-Off Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP 1 or other agreed upon methods.
7. Power Tool Cleaning to Bare Metal, SSPC-SP11: Metallic surfaces that are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted. Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods.
8. Near-White Blast Cleaning, SSPC-SP10 or NACE 2: A Near White Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 5 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
9. High- and Ultra-High Pressure Water Jetting for Steel and Other Hard Materials: SSPC-SP12 or NACE 5: This standard provides requirements for the use of high- and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream.
10. Water Blasting, SSPC-SP12/NACE No. 5: Removal of oil grease dirt, loose rust, loose mill scale, and loose paint by water at pressures of 2,000 to 2,500 psi at a flow of 4 to 14 gallons per minute.

M. Vinyl Siding, Architectural Plastics, EIFS and Fiberglass: Clean vinyl siding thoroughly by scrubbing with a warm, soapy water solution. Rinse thoroughly. Do not paint vinyl siding with any color darker than the original color unless the paint system features Sherwin-Williams VinylSafe technology. Painting with darker colors that are not Sherwin-Williams VinylSafe may cause siding to warp. Follow all painting guidelines of the vinyl manufacturer when painting. Only paint properly installed vinyl siding. Deviating from the manufacturer's painting guidelines may cause the warranty to be voided.

N. Stucco: Must be clean and free of any loose stucco. If recommended procedures for applying stucco are followed, and normal drying conditions prevail, the surface may be painted in 30 days. The pH of the surface should be between 6 and 9 unless the products are designed to be used in high pH environments such as Loxon.

O. Wood: Must be clean and dry. Prime and paint as soon as possible. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.

3.3 INSTALLATION

A. Apply all coatings and materials with the manufacturer's specifications in mind. Mix and thin coatings according to manufacturer's recommendations.

B. Do not apply it to wet or damp surfaces. Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days. Test new concrete for moisture content. Wait until wood is fully dry after rain or morning fog or dew.

C. Apply coatings using methods recommended by manufacturer.

D. Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.

E. Apply coatings at spreading rate required to achieve the manufacturers recommended dry film thickness.

F. Regardless of the number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.

G. Inspection: The coated surface must be inspected and approved by the Architect just prior to the application of each coat.

3.4 PROTECTION

A. Protect finished coatings from damage until completion of project.

B. Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION

SECTION 09 96 00 – HIGH PERFORMANCE COATING

GENERAL

1.1 SECTION INCLUDES

A. Interior and exterior coatings as specified herein.

1.2 RELATED SECTIONS

A. Section 0512000 – Structural Steel Framing

B. Section 07 81 00 - Applied Fireproofing

1.3 REFERENCES

A. Occupational Safety and Health Act (OSHA) - Safety Standards.

B. American National Standards Institute (ANSI) - Performance Standards.

C. Paint Decorating Contractors of America (PDCA) - Application Standard.

D. National Paint and Coatings Association (NPCA) - Gloss Standard.

E. American Society for Testing Materials (ASTM) - Testing Methods.

F. Master Paint Institute (MPI #) - Established paint categories and standards.

G. Ozone Transmission Commission (OTC) - Established levels of Volatile Organic Compounds.

H. SCAQMD 1168 - South Coast Air Quality Management District Rule #1168; October 3, 2003.

I. SSPC (PM1) - Steel Structures Painting Manual, Vol. 1, Good Painting Practice; Society for Protective Coatings; 1993, Third Edition.

J. SSPC (PM2) - Steel Structures Painting Manual, Vol. 2, Systems and Specifications; Society for Protective Coatings; 1995, Seventh Edition.

K. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

1.4 DEFINITIONS

A. Commercial as used in this Section refers to a product well suited for a commercial application.

B. DFT as used in this Section refers to the Dry Film Thickness of the coating.

C. Enamel refers to any acrylic or alkyd (oil) base paint which dries leaving an eggshell, pearl, satin, semi-gloss or high gloss enamel finish.

D. DTM as used in this Section refers to paint that is applied Direct To Metal.

E. OTC as used in this Section refers to the Ozone Transmission Commission. OTC has established the following VOC levels for the Northeastern United States. Products shall meet

the following OTC limits for VOC's.

1. Interior flat paints: 100 grams per liter or less, per gallon.
2. Interior enamels: 150 grams per liter or less, per gallon.
3. Interior stains: 250 grams per liter or less, per gallon.
4. Interior primers: 200 grams per liter or less, per gallon.
5. Rust preventive coatings: 400 grams per liter or less, per gallon.
6. Dry fog coatings: 400 grams per liter or less, per gallon.
7. Floor coatings: 250 grams per liter or less, per gallon.

F. Premium as used in this Section refers to the best quality product "top of the line".

G. VOC as used in this Section refers to Volatile Organic Compounds found in primers, paints, sealers and stains. The level of VOCs appears after each product listed in the Schedule in grams per liter (g/L).

H. Paints are available in a wide range of sheens or glosses, as measured by a gloss meter from a 60 and/or 85 degree angle from vertical, as a percentage of the amount of light that is reflected. The following terms are used to describe the gloss of our products. The list below is provided for general guidance; refer to the technical data sheet for the actual gloss/sheen level for each product.

1. Flat - Less than 5 Percent.
2. Eggshell - 5 - 20 Percent.
3. Satin - 20 - 35 Percent.
4. Semi-Gloss - 30 - 65 Percent.
5. Gloss - Over 65 Percent.

1.5 SUBMITTALS

A. Submit under provisions of Section 013300 – Submittal Procedures.

B. Product Data: Provide a complete list of all products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category.
2. Cross-reference to specified paint system(s) that the product is to be used in; include description of each system.

C. Samples: Submit three paper samples, 5 inches by 7 inches (127mm x 178mm) in size, illustrating selected colors for each color and system selected with specified coats cascaded.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.

B. Installer Qualifications: All products listed in this section are to be applied by a Painting Contractor with a minimum of five years demonstrated experience in surface preparation and field application of the same type and scope as specified.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and

application workmanship.

1. Mock-up areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Approved mock-up areas will serve as the standard for remaining Work.
4. Refinish mock-up area as required to produce acceptable Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

C. Disposal:
1. Never pour leftover coating down any sink or drain. Use up material on the job or seal can and store safely for future use.
2. Do not incinerate closed containers.
3. For specific disposal or recycle guidelines, contact the local waste management agency or district. Recycle whenever possible.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

A. Inspection of all surfaces to be coated must be done by the manufacturer's representative to insure proper preparation prior to application. All thinners, fillers, primers and finish coatings shall be from the same manufacturer to support a product warranty. Products other than those submitted shall be accompanied by a letter stating its fitness for use and compatibility.

B. At project closeout, provide to the Owner or owner's representative an executed copy of the Manufacturer's standard form outlining the terms and conditions of and any exclusions to their Limited Warranty against Manufacturing Defect.

1.10 EXTRA MATERIALS

A. At project closeout, supply the Owner or owner's representative one gallon of each product for touch-up purposes. Cans shall be clearly marked with color name, number and type of paint.

B. At project closeout, provide the color mixture name and code to the Owner or owner's representative for accurate future color matching.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tnemec Company: Basis of Design

B. Sherwin Williams

C. Substitutions:
   1. Approved Equal.

2.2 MATERIALS - GENERAL

A. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D-National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

B. Compatibility: Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.3 MIXING AND TINTING

A. Except where specifically noted in this section, all paint shall be ready-mixed and pre-tinted. Agitate all paint prior to and during application to ensure uniform color, gloss, and consistency.

B. Thinner addition shall not exceed manufacturer's printed recommendations. Do not use kerosene or other organic solvents to thin water-based paints.

2.4 HIGH PERFORMANCE PAINT SPECIFICATION

A. INTERIOR EXPOSED AND CONCEALED STEEL **- NOT IN NATATURIUM**

SEE DRAWINGS (Includes Structural Steel Columns, Joists, Trusses, Beams, Miscellaneous and Ornamental Iron, Structural Iron, Ferrous Metal, etc).

Shop Surface Preparation: Abrasive blast in accordance with SSPC-SP6 Commercial Blast Cleaning.

Field Touch-up Surface Preparation: Spot power tool clean in accordance with SSPC-SP11 Power Tool Clean to Bare Metal. Feather-edges.

1) 1st Coat (Shop & Field Touch-Up) Tnemec Series 90G-1K97 Tneme-Zinc 2.5-3.5 dry mils
2) 2nd Coat: Tnemec Series 66 Epoxoline 4.0-6.0 dry mils
3) 3rd Coat: Tnemec Series 66 Epoxoline 4.0-6.0 dry mils

B. EXPOSED AND CONCEALED STEEL - IN NATATORIUM AND IN ADJACENT AREAS SUBJECT TO HIGH HUMIDITY, ELEVATED TEMPERATURES OR CHLORINE/CHLORAMINE EXPOSURE.
   1. See drawings for limits of this area
   2. Fire and steel protection to be by one manufacturer, see spec section 07 81 00 Applied fireproofing.

C. WALLS IN NATATORIUM

D. INTERIOR STAIRS (Adjacent to Pool Equipment Room)

Shop Surface Preparation: Abrasive blast in accordance with SSPC-SP6 Commercial Blast Cleaning.

Field Touch-up Surface Preparation: Spot power tool clean in accordance with SSPC-SP11 Power Tool Clean to Bare Metal. Feather-edges.

1) 1st Coat (Shop & Field Touch-Up) Tnemec Series 90G-1K97 Tneme-Zinc 2.5-3.5 dry mils
2) 2nd Coat: Tnemec Series 66 Epoxoline 4.0-6.0 dry mils
3) 3rd Coat: Tnemec Series 290 CRU 2.0-3.0 dry mils

E. CMU BLOCK IN MAINTENANCE SHOP

Surface Preparation: Allow mortar to cure for 14 days. Level protrusions and mortar spatter.

1) 1st Coat Tnemec Series 130 Envirofill at 60-80 Sq ft/Gal
2) 2nd Coat: Tnemec Series 66 Epoxoline 2.0-3.0 dry mils
3) 3rd Coat: Tnemec Series 66 Epoxoline 2.0-3.0 dry mils

F. CMU BLOCK, RAILING & LADDER IN POOL EQUIPMENT ROOM

Surface Preparation: Allow mortar to cure for 14 days. Level protrusions and mortar spatter.

1) 1st Coat Tnemec Series 130 Envirofill at 60-80 Sq ft/Gal
2) 2nd Coat: Tnemec Series 66 Epoxoline 4.0-6.0 dry mils
3) 3rd Coat: Tnemec Series 290 CRU 2.0-3.0 dry mils

G. OVERHEAD STEEL IN MAINTENANCE SHOP

1) Shop Surface Preparation: Power Tool Clean in accordance with SSPC-SP3.
2) Field Touch-up Surface Preparation: Spot power tool clean in accordance with SSPC-SP3 Power Tool Clean.. Feather-edges.

1) 1st Coat (Shop & Field Touch-Up) Tnemec Series 10-99W (white) 2.5-3.5 dry mils
2) 2nd Coat: Tnemec Series 115 Unibond 3.0-4.0 dry mils

H. OVERHEAD DECKING IN MAINTENANCE SHOP

Shop Surface Preparation: In accordance with manufacturer’s instructions.

1) 1st Coat Tnemec Series 115 Unibond 3.0-4.0 dry mils

I. EXTERIOR STEEL PLATFORM FOR COOLING TOWER

Shop Surface Preparation: Abrasive blast in accordance with SSPC-SP6 Commercial Blast Cleaning.

Field Touch-up Surface Preparation: Spot power tool clean in accordance with SSPC-SP11 Power Tool Clean to Bare Metal. Feather-edges.

1) 1st Coat (Shop & Field Touch-Up) Tnemec Series 90G-1K97 Tneme-Zinc 2.5-3.5 dry mils
2) 2nd Coat: Tnemec Series 66 Epoxoline 4.0-6.0 dry mils

3) 3rd Coat: Tnemec Series 1095 Endura-Shield 2.0-3.0 dry mils

J. CONCRETE FLOORS IN POOL EQUIPMENT ROOM – SEE FLOORING SEPCIFICATION

K. LOCKER ROOMS, SEE DRAWINGS.

L. Reference drawings and legends for other areas requiring high performance coatings.

PART 3 EXECUTION

3.1 EXAMINATION

A. The Contractor shall review the product manufacturer's special instructions for surface preparation, application, temperature, re-coat times, and product limitations.

B. The Contractor shall review product health and safety precautions listed by the manufacturer.

C. The Contractor shall be responsible for enforcing on site health and safety requirements associated with the Work.

D. Do not begin installation until substrates have been properly prepared.

E. Ensure that surfaces to receive paint are dry immediately prior to application.

F. Ensure that moisture-retaining substrates to receive paint have moisture content within tolerances allowed by coating manufacturer. Where exceeding the following values, promptly notify Architect and obtain direction before beginning work.
1. Concrete and Masonry: 3-5 percent. Allow new concrete to cure a minimum of 28 days.
2. Exterior Wood: 17 percent.
3. Interior Wood: 15 percent.
4. Interior Finish Detail Woodwork, Including Trim, and Casework: 10 percent.
5. Plaster and Gypsum: 15 percent.
6. Concrete Slab-On-Grade: Perform calcium chloride test over 24 hour period or other acceptable test to manufacturer. Verify acceptable moisture transmission and pH levels.

G. Examine surfaces to receive coatings for surface imperfections and contaminants that could impair performance or appearance of coatings, including but not limited to, loose primer, rust, scale, oil, grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.

H. Correct conditions that could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.2 PREPARATION - GENERAL

A. Clean surfaces thoroughly prior to coating application.

B. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.

C. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; cover stains and marks which cannot be completely

removed with isolating primer or sealer recommended by coating manufacturer to prevent bleed-through.

D. Remove Mildew, Algae, and Fungus using materials and methods recommended by coating manufacturer.

E. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.

F. Remove or protect adjacent hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings.

G. Move or protect equipment and fixtures adjacent to surfaces indicated to receive coatings to allow application of coatings.

H. Protect adjacent surfaces not indicated to receive coatings.

I. Prepare surfaces in accordance with manufacturer's instructions for specified coatings and indicated materials, using only methods and materials recommended by coating manufacturer.

3.3 APPLICATION - GENERAL

A. Application of primers, paints, stains or coatings, by the Contractor, will serve as acceptance that surfaces were properly prepared in accordance with the manufacturer's recommendation.

B. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.

C. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.

D. Inspect each coat before applying next coat; touch-up surface imperfections with coating material, feathering, and sanding if required; touch-up areas to achieve flat, uniform surface without surface defects visible from 5 feet (1.5 m).

E. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

F. Where paint application abuts other materials or other coating color, terminate coating with a clean sharp termination line without coating overlap.

G. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.

H. Re-prepare and re-coat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

I. Apply all coatings in accordance with manufacturer’s written sinstructions.

3.4 CLEANING

A. Clean excess coating materials, and coating materials deposited on surfaces not indicated to receive coatings, as construction activities of this section progress; do not allow to dry.

B. Re-install hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items that have been removed to protect from contact with coatings.

C. Reconnect equipment adjacent to surfaces indicated to receive coatings.

D. Relocate to original position equipment and fixtures that have been moved to allow application of coatings.

E. Remove protective materials.

3.5 PROTECTION AND REPAIR

A. Protect completed coating applications from damage by subsequent construction activities until completion of painting project.

B. Touch-up coatings damaged by subsequent construction activities.

END OF SECTION 099600

DIVISION

10

SPECIALTIES

SECTION 10 11 00 – GLASSBOARDS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes tempered safety glass writing boards and accessories for wall-mounted installations.
B. Types include:

1. Clarus Glass Wall2Wall panels.
2. ColorDrop™ glassboards.

1.2 REFERENCES

A. ASTM C1048 – Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
B. ANSI Z97.1 – Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.
C. ASTM E84 – Surface Burning Characteristics of Building Materials.
D. NFPA 101 – Life Safety Code.

1.3 SUBMITTALS

A. Product Data: Manufacturer's technical data, fabrication details, installation instructions, and maintenance recommendations.
B. Shop Drawings: Indicate sizes, mounting details, locations of cutouts, holes, and notches.
C. Color and Finish Samples: Submit manufacturer's standard glass color samples D. Warranty Documentation.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Clarus, or approved equal, with minimum 10 years' experience manufacturing glass visual display systems.
B. Installer Qualifications: Experienced in installation of architectural glass wall systems.
C. Mock-Up: Provide 24 by 24 inch sample for evaluation of appearance and mounting.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original packaging, labeled for identification.
B. Store glass units vertically on cushioned supports, in a clean, dry area protected from damage and moisture.
C. Handle glass carefully to prevent edge damage and surface scratching.

1.6 WARRANTY

A. Provide manufacturer's **20-year warranty** covering defects in materials, workmanship, staining, and ghosting.
B. Warranty includes lifetime performance of the writing surface.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: **Clarus Glassboards**, Clarus, Fort Worth, Texas.
Website: www.clarus.com or approved equal
B. Substitutions: Comply with Division 01 requirements for substitutions.

2.2 MATERIALS

A. **Glass Panel:**

1. 1/4 inch (6 mm) Clarus tempered safety glass, conforming to ASTM C1048, Kind FT, Condition A.
2. Low-iron, optically clear glass for superior color fidelity and clarity.
3. Clarus Opti-Clear™ polished edges with eased corners for safety.
4. Non-porous, non-staining surface compatible with all markers, including permanent.
5. Bacteria-resistant and scratch-resistant surface.
6. Class A flame spread rating; Zone 4 earthquake compliant.
7. Dimensions: See drawings.

B. **Colors and Printing:**

1. Colors: Architect to select color from full range of manufacturer's colors.
2. Printing: ColorDrop™ proprietary direct-to-glass UV printing for custom graphics, logos, and patterns.
    - Guaranteed not to fade or discolor.
3. Finish Options: Magnetic and non-magnetic glass surfaces.

C. **Mounting System:**

1. Clarus TruMount™ patented, multi-directional, micro-adjustable hardware system.
2. Supports up to 6,500 pounds without structural blocking or reinforcement.
3. Channel and trim included for clean installation.

2.3 ACCESSORIES

A. Mounting channels, trims, and all fasteners required for complete installation.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify wall surfaces are flat, plumb, smooth, and prepared for mounting.
B. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install glassboards in accordance with manufacturer's written instructions and approved shop drawings.
B. Secure TruMount™ hardware to substrate per manufacturer's requirements.
C. Set glass panels accurately, level, plumb, and true with uniform joints.
D. Protect exposed edges from damage during installation.

3.3 CLEANING AND PROTECTION

A. Clean glass and metal surfaces immediately after installation using manufacturer-approved cleaners.
B. Protect installed glassboards from damage until project completion.

END OF SECTION 10 11 00

SECTION 10 22 26 OPERABLE PARTITIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Electrically operated, continuously hinged partitions.
B. Related Sections include the following:
   1. Division 03 30 00 Section for concrete tolerances required.
   2. Division 05 Section 05 12 00 for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
   3. Division 06 Section 06 10 00 for wood framing & supports, and all blocking at head and jambs as required.
   4. Division 09 Section 09 22 16 for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 *Standard Practice for Architectural Application and Installation of Operable Partitions.*
D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.

1.4 REFERENCE STANDARDS

A. ASTM International
   1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
   2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   3. ASTM C1036 - Standard Specification for Flat Glass.
   4. ASTM C1048 - Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
   5. ASTM E84 - Surface Burning Characteristics of Building Materials.
   6. ASTM E413 - Classification for Rating Sound Insulation
B. Health Product Declaration Collaborative
   1. Health Product Declaration Open Standard v2.1
C. International Standards Organization
   1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
   2. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
   3. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.
   4. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.

5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.

D. Other Standards
   1. ADA – Americans with Disabilities Act.
   2. UL 508A – Standard for Industrial Control Panels
   3. NFPA 70 – National Electrical Code
   4. ANSI Z97.1 - Safety Glazing Materials Used in Buildings.
   5. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
   6. NEMA LD3 - High Pressure Decorative Laminates.

1.5 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
E. Reports: Provide a complete and unedited written sound test report indicating test specimen matches product as submitted.
F. Create spaces that are healthy for occupants.
   1. Furnish products and materials with Health Product Declaration (HPD), Manufacturer Inventory, or other material health disclosure documentation. Products without an HPD or other disclosure documentation are not acceptable.
G. Furnish materials that generate the least amount of pollution.
   1. Furnish products and materials that have third party verified environmental product declarations (EPD's). Consider products and materials that have optimized environmental performance (reduced life cycle impacts). Products without an EPD or other disclosure documentation are not acceptable.
H. Buy American: Folding door to be manufactured in the United States in compliance with applicable U.S. Federal Trade Commission (FTC) and U.S. Customs Service and Border Protections regulations and be labeled "Made in America".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
B. Warranty period: Two (2) years.
C. Suspension System Warranty:
   1. OP-01: Ten (10) years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

A. Manufacturers: Subject to compliance with requirements, provide product by the following:
   1. Modernfold, Inc.or approved equal.
B. Doors to be manufactured in the U.S.A.
C. Products: Subject to compliance with the requirements, provide the following product:
   1. OP-01: Acousti-Seal Legacy - Electric Panel: Electrically operated continuously hinged operable partition.

2.2 OPERATION

A. OP-01: Acousti-Seal Legacy - Electric Panel: Series of continuously hinged flat panels, electrically operated, top supported with operable floor seals.
B. Final Closure:
   1. OP-01: Side Jamb with overlapping trail panel with "Modernfold Presto Automation Package". (For complete specification see Presto Package brochure Form #2514)
C. Partition shall be operated by:
   1. OP-01: Modernfold Presto ® Automation Package with Touch Screen Operator Control Station by Modernfold, Inc.
D. Electric motor shall consist of:
   1. OP-01: A 208-volt, 3-phase

2.3 PANEL CONSTRUCTION

A. OP-01: Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
B. Panel skin shall be:
   1. OP-01: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
      a. 52 STC
C. Hinges for Panels, Closure Panels, Pass Doors, and Pocket Doors shall be:
   1. OP-01: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
E. Panel Weights:
   1. OP-01: 52 STC - 11 lbs./square foot

2.4 PANEL FINISH

A. Panel finish shall be:
   1. OP-01: Wall covering and upholstery fabric with surface treatment to resist stains.
B. Panel Trim: Exposed panel trim of one consistent color:
   1. OP-01: by Architect.

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.

B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
C. Horizontal bottom floor seals shall be:
   1. OP-01: Modernfold IA2 Bottom seal. Automatic operable seals providing nominal 2-inch (51mm) operating clearance with an operating range of +0.50-inch (13mm) to -1.50-inch (38mm) which automatically drop as panels are positioned, without the need for tools or cranks.

2.6 SUSPENSION SYSTEM

A. OP-01: #14 Suspension System
   1. Suspension Tracks: Minimum 7-gauge, 0.18-inch (4.57mm) roll formed steel. Static loading of track with brackets at 48-inch (1220mm) centers shall show no failure of track or brackets at 5,000 pounds (2550kg) point loading at mid-span. Track shall be supported by adjustable steel hanger brackets connected to structural support pairs of 0.50-inch (13mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
      a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.

2.7 OPTIONS

A. "Presto" Safety Components:
   1. OP-01: Presto Safety Nose (wireless) – High sensitivity pressure leading edge requiring no more than 2.2 lb. of pressure to stop partition movement in case of obstruction. Lead sensors requiring hard wiring through partition system or requiring more than 2.2 lb. of pressure for activation are not acceptable. Sensing edge to be housed in fluid resistant housing and set in snap in channel for easy maintenance and be provided with 4-lead fail-safe wiring.
   2. OP-01: Presto Safety Mats – Located at panel storage area. Personnel sensing switch mat shall activate with the presence of a minimum 22 lb. obstruction in the stack area and prevent panels from stacking until the personnel/obstruction is removed. Mats shall be provided with 4-lead fail-safe wiring.
   3. OP-01: Presto Vision (PIR/Microwave Detector) – Wall or ceiling mounted motion sensors covering the travel area of the automated partition shall automatically stop the movement of the panels in the presence of unauthorized movement or obstruction. Detector can detect motion in an area up to 300 ft. (91M) long by 7.5 ft. (2.3M) wide and 10 ft. (3M) high.
   4. OP-01: Modernfold Presto ® Automation Package (see supplement specification "Modernfold Presto ® Automation Package For Acousti-Seal Encore Automated Wall System"
B. Available accessories/options:
   1. OP-01: Pocket Doors: Acousti-Seal Pocket Doors by Modernfold, Inc. Equipped with electric interlock system. (see supplement specification)
      a.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer’s written instructions.
B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

A. Demonstrate proper operation and maintenance procedures to Owner's representative.
B. Provide Operation and Maintenance Manual to Owner's representative.

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215 West New Road
Greenfield, IN 46140
Toll Free: 800.869.9685
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www.modernfold.com

SECTION 10 28 00 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Patient and Staff washroom accessories.
2. Patient shower room accessories.
3. Under lavatory guards.

B. Owner-Furnished Material: Soap dispensers, towel dispensers, waste receptacle and shower curtain

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PATIENT AND STAFF WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bobrick Washroom Equipment, Inc.
2. A & J Washroom Accessories, Inc.
3. American Specialties, Inc.
4. Bradley Corporation.

C. Standard Grab Bar

1. Basis of Design Product: Bobrick B-6806 99 x 36", 48" and 18"
2. Mounting: Flanges with concealed fasteners
3. Material: Stainless Steel 0.05 inch thick
   a. Finish: Smooth No 4 finish (satin) on ends and slip resistant texture in grip area
4. Outside diameter: 1-1/2: inches
5. Configuration and length: As indicated on drawings

D. Bariatric Grab: Custom fabrication as indicated on drawings and as follows:

1. Location: Bariatric Toilet Room 241
2. Mounting: flanges with concealed fasteners
3. Material: Stainless steel 0.05 inch thick
   a. Finish: Smooth No 4 finish (satin) on ends and slip resistant texture in grip area
4. Outside diameter: 1-1/2: inches
5. Configuration and length: As indicated on drawings

E. Mirror

1. Basis of Design Product: Bobrick B-290
2. Welded frame.
3. Hangers: Produce rigid, tamper-and theft-resistant installation, using method indicated below
   a. One-piece, galvanized steel, wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts
   b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove
4. Size: 24"W x 36"H

F. Sanitary Napkin Disposal

1. Basis of Design: Bobrick B-270
2. Size: 7-1/2" x 10" x 3-13/16"
3. Material: 22-gauge, type-304 stainless steel with satin finish; all-welded construction

2.3 PATIENT SHOWER ROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bobrick Washroom Equipment, Inc.

2. A & J Washroom Accessories, Inc.
3. American Specialties, Inc.
4. Bradley Corporation.

C. Shower Curtain Rod

1. Description: 1-inch (25.4-mm) OD; fabricated from nominal 0.0375-inch- (0.95-mm-) thick stainless steel
2. Location: Patient Shower & Toilet Room 319
3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners
4. Finish: No. 4 (satin)

D. Folding Shower Seat

1. Basis-of-Design Product: Bobrick B5191
2. Configuration: Compact design
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect]
4. Location: Patient Shower & Toilet Room 324A
5. Mounting Mechanism: Stainless steel, No. 4 finish (satin)]
6. Dimensions: 18”W x 16”D, 5-1/2” from wall when in folded position, mounting height between 17”-19”

2.4 OTHER ACCESSORIES

A. Recessed Specimen Pass-Through Cabinet

1. Basis of Design: B-50516.
2. Size: 10”x12”.
3. Location: Patient Toilet Room 207A
4. Mounting Height: Refer to drawings.
5. Materials: 20 gauge, type 304 satin stainless steel all-welded construction

B. Specimen Shelf

1. Basis of Design: Bobrick B-295
2. Size: 16” x 5”
3. Location: Patient Toilet Room 207A
4. Mounting Height: Refer to drawings.
5. Material: 18-gauge, type 304 satin stainless steel.
6. Edges: ¾” return edges.
7. Blocking: Provide in-wall wood blocking per manufacturer’s instructions.

2.5 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

C. Under Lavatory Guard

1. Retain "Basis-of-Design Product" Subparagraph below if applicable. Coordinate with specification method retained above.

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Standard Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Sections:
1. Division 10 Section 10 44 16 "Fire Extinguishers."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

1.4 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished)

2.2 FIRE PROTECTION CABINET

A. Cabinet Type:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:

   a. No SS2409- R3 by Larsen's Manufacturing Company;
   b. No 7052-DV by Potter Roemer LLC;

B. Cabinet Construction: Nonrated and rated if applicable

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Aluminum sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Rolled-Edge Trim: 4-inch (102-mm backbend depth.

E. Door Material: Aluminum sheet

F. Door Style: Full panel.

G. Door Glazing:

1. Clear tempered safety glass. .

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch

2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle
3. Provide concealed hinge of same material permitting door to open 180 degrees.

I. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER"

1) Location: Applied to cabinet door
2) Application Process: Die cut
3) Lettering Color: White.
4) Orientation: Vertical

J. Finishes:
1. Baked enamel, red.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.
4. Dull Satin Finish: No. 6.
5. Reflective, Directional Polish: No. 7.
6. Mirrorlike Reflective, Nondirectional Polish: No. 8.

C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below

1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

B. Related Sections:
   1. Division 10 Section "Fire Extinguisher Cabinets."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.

b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: 10lb ABC Extinguisher

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amerex Corporation.
   b. Ansul Incorporated; Tyco International Ltd.
   c. Badger Fire Protection; a Kidde company.
   d. Buckeye Fire Equipment Company.
   e. Fire End & Croker Corporation.
   f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
   g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
   h. Larsen's Manufacturing Company.
   i. Moon-American.
   j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
   k. Potter Roemer LLC.
   l. Pyro-Chem; Tyco Safety Products.
2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Portable fire extinguisher in the Pool Mechanical Room.

1. In accordance with the requirements of NFPA 10, manual firefighting equipment in the form of portable water fire extinguishers of water hose reel stations shall be provided. The placement and use of multipurpose dry chemical extinguishers (Class A:B:C) is specifically prohibited in areas where oxidizers that can release chlorine are stored. The reaction between chlorine-containing oxidizers and the ammonium salts in the fire extinguishing agent may produce an explosive compound (NCl_3). Carbon dioxide or other agents that depend on their smothering action for effective use will be of no value in extinguishing fire involving oxidizers. Halon extinguishers should not be used on fires involving oxidizers because they may react with the oxidizer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION

SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Four-post metal storage shelving.

B. Owner-Provided, Contractor-Installed Materials: Loose and miscellaneous storage items.

C. Related Sections:

1. Division 11 Section "Foodservice Equipment" for metal shelving in kitchen, pantry, and refrigerated spaces.
2. Division 11 Section "Library Stack Systems" for library shelving systems including cantilever-bracket shelving supported by wall-mounted standards.
3. Division 12 Section "Laboratory Casework" for metal shelving in laboratories.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance for Four-Post Metal Storage Shelving: Capable of withstanding the loads indicated according to MH 28.1.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.

B. Shop Drawings: For customized metal storage shelving. Include plans, elevations, sections, details, and attachments to other work. Include installation details of connectors, lateral bracing, and special bracing.

C. Samples for Initial Selection: For units with factory-applied color finishes. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following components, of size indicated below:

1. Vertical Posts: 12 inches tall.
2. Shelves: Full size, but not more than 24 inches wide by 12 inches deep.
3. Connectors for Shelf to Post: Full size.
4. Shelf-Label Holders: Full size.

E. Product Schedule: For metal storage shelving.

F. Delegated-Design Submittal: For metal storage shelving indicated to comply with performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Qualification Data: For qualified Installer.

H. Product Certificates: For each type of metal storage shelving from manufacturer.

I. Maintenance Data: For metal storage shelving to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain metal storage shelving from single source from single manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.8 EXTRA MATERIALS

A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Shelves: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than five shelves.
2. Shelf-to-Post Connectors: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 connectors.
3. Shelf-Label Holders: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 holders.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with **G60** zinc (galvanized) or **A60** zinc-iron-alloy (galvannealed) coating.

D. Steel Tubing: ASTM A 513, Type 2.

E. Steel Wire: ASTM A 899.

F. Floor Anchors: Galvanized-steel, post-installed expansion anchors, power-actuated fasteners or threaded concrete screws. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.

G. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

2.2 FOUR-POST METAL STORAGE SHELVING

A. Open Four-Post Metal Storage Shelving: Factory-formed, field-assembled, freestanding system, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units as add-on units, designed to share two corner posts with initial shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hallowell; Division of List Industries, Inc.
    b. Lyon Workspace Products, LLC.
    c. Penco Products, Inc.

2. Load-Carrying Capacity per Shelf: 700 lb.
3. Posts: Fabricated from hot-rolled steel; in box shape; with perforations at 1-1/2 inches o.c. to receive shelf-to-post connectors.

    a. Steel Thickness, Nominal: 0.075 inch and as required for load-carrying capacity per shelf and number of shelves.
    b. Add-On Shelf Posts: Fabricated from hot-rolled steel, manufacturer's standard shape; perforated to match main posts and of same thickness.
    c. Post Base: Bolt leveler.

4. Bracing: Manufacturer's standard, single diagonal cross bracing at back; as required for stability, load-carrying capacity of shelves, and number of shelves.
5. Framed-Type Wire Shelves: Steel wire; with shelf frame fabricated from same material and with same finish as posts.
6. Shelf Quantity: Six shelves per shelving unit in addition to top and bottom shelf.
7. Shelf-to-Post Connectors: Adjustable compression clips.
8. Base: Open, with exposed post legs.
9. Overall Unit Width: 30 inches, unless otherwise indicated. Or, in lengths not evenly divisible by the above width, and roughly divisible by another standard width, use the appropriate width to fill the run.
10. Overall Unit Depth: 12 inches at all administration, classroom and front-of-house applications, 18 inches at all athletic applications, and 24 inches for all back-of-house and janitorial applications.
11. Overall Unit Height: 72 inches at all administration and classroom applications, 96 inches at all janitorial and back-of-house applications.
12. Accessories:

    a. Shelf Dividers: Fabricated from same material and with same finish as shelves; removable, sliding type. Provide at all office and administration applications.

b. Removable Bins: Fabricated from same material and with same finish as shelves; provide at all janitorial applications, at bottom shelf and sized to fit.
c. Shelf-Label Holders: Colored plastic, designed to clip onto front edge of shelf. At all administration and office applications.

13. Finish: Baked enamel or powder coat.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

A. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Fabricate metal storage shelving square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.

1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
3. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
4. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.

C. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2-inch- wide hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch. Shear and punch metals cleanly and accurately. Remove burrs.

E. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling."

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where metal storage shelving will be installed.

C. Examine walls and ceilings to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Vacuum finished floor and wet mop resilient flooring over which metal storage shelving is to be installed.

3.3 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.

1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
3. Adjust post-base bolt leveler to achieve level and plumb installation.
4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
5. Connect side-to-side and back-to-back shelving units together.
6. Install shelves in each shelving unit at spacing indicated on Drawings or, if not indicated, at equal spacing.

    a. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

B. Accessories:

1. Shelf Dividers: Install full-height dividers per shelf.
2. Bins: Install two per bottom shelf in all janitorial applications.
3. Shelf-Label Holders: Install one on each shelf, vertically aligned within each shelving unit.

3.4 ERECTION TOLERANCES

A. Erect four-post metal storage shelving to a maximum tolerance from vertical of **1/2 inch** in up to **10 feet** of height, not exceeding **1 inch** for heights taller than **10 feet**.

3.5 ADJUSTING

A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

D. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 56 13

SECTION 107113: EXTERIOR SUN CONTROL DEVICES

GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section covers Kawneer Aluminum Sunshade Systems, including accessories, mountings, and shims. Sunshades are anchored directly to the vertical and/or horizontal mullions.

B. Types of Kawneer Sunshades include:
   1. Versoleil® SunShade Horizontal Single Blade System compatible with:
      a. 1600 Wall System®1 Curtain Wall System

1.3 DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance:
   1. Combined load on sunshade configurations to be determined in accordance with ASCE 7 or applicable code requirements. Combined load consists of wind, snow and ice loads.
   2. Design sunshade configurations to withstand stresses due to combined load. Stresses resulting from thermal expansion/contraction, shall not cause permanent deformation of sunshade assemblies or disengagement from the glazed system.
   3. The assembled sunshade shall be capable of supporting the specified combined load without damage, permanent deformation, or disengagement from the glazed system mullion.
   4. Blade deflection shall not exceed L/120 of span length.
   5. Submit test reports verifying compliance with each test requirement required by the project.

B. Shading Performance:
   1. Design pressures shall comply with ASCE 7-16 for Risk Category III (if applicable), Exposure C, and a basic wind speed of 140 mph, in accordance with IBC as adopted by the Louisiana State Uniform Construction Code Council for Houma, LA.
   2. Attachment to curtain wall mullions must not compromise the integrity of the hurricane-impact-resistant curtain wall system.

C. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures.
   1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.

D. Environmental Product Declaration (EPD): Shall have a Type III Product-Specific EPD.

1.5 SUBMITTALS

A. Product Data:
   1. For each type of product indicated, include:
      a. Construction details
      b. Material descriptions
      c. Dimensions of individual components and profiles
      d. Finishes
      e. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content.

B. Shop Drawings:
   1. Plans
   2. Elevations
   3. Sections
   4. Blade angles
   5. Blade spacing
   6. Attachments to other compatible systems work

C. Samples for Initial Selection:
   1. Provide samples for units with factory-applied color finishes.
   2. Provide samples of hardware and accessories involving color selection.

D. Samples for Verification:
   1. Provide a verification sample for each type of exposed finish required, in manufacturer's standard sizes.
   2. Optimize Energy Performance: Provide information confirming that products contribute to increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.
   3. Daylighting 75 percent of Spaces: Provide information confirming that products provide the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer must have successfully installed the same or similar systemsrequired for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:

C. Source Limitations:
   1. Obtain aluminum exterior sunshades and glazed aluminum curtain walls and storefront system through one source from a single manufacturer.

D. Product Options:
   1. Information on drawings and in specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups:
   1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

F. Pre-installation Conference:
   1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

1.7 PROJECT CONDITIONS

A. Field Measurements:
   1. Verify actual locations of structural supports for sunshades by field measurements before fabrication.
   2. Indicate measurements on shop drawings.

1.8 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:
   1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product:
   1. Kawneer Company, Inc.
      a. Versoleil® Single Blade Horizontal Sunshade or approved equal

2.2 MATERIALS

A. Aluminum Extrusions:
   1. Alloy and temper recommended by glazed aluminum curtain wall and storefront manufacturer for strength, corrosion resistance, and application of required finish
   2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame
   3. Complying with ASTM B221: 6063-T6 alloy and temper

B. Thermal Barrier:
   1. When applied on a thermally broken captured system, sunshade shall be thermally isolated from the interior aluminum mullions by a nominal 0.25" (6.3) thick low conductance material.

C. Aluminum Sheet Alloy:
   1. Shall meet the requirements of ASTM B209.

D. Sealant:
   1. For sealants required within fabricated sunshade system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

E. Tolerances:
   1. References to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall and storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 SUNSHADES

A. Sunshade Members:
   1. Manufacturer's standard extruded or formed-aluminum framing members of thickness and reinforced as required to support imposed loads.

B. Fasteners and Accessories:
   1. Nonmagnetic stainless steel to be non-corrosive and compatible with aluminum members, anchors, and other components.

C. Perimeter Anchors:
   1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

D. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

E. Storage and Protection:
   1. Store materials so that they are protected from exposure to harmful weather conditions.
   2. Handle material and components to avoid damage.
   3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.4 ACCESSORY MATERIALS

A. Bituminous Paint:
   1. Cold-applied asphalt-mastic paint
   2. Complies with SSPC-Paint 12 requirements except containing no asbestos
   3. Formulated for 30-mil (0.762 mm) thickness per coat

2.5 FABRICATION

A. Extrude or form aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations
   2. Accurately fitted joints that are flush, hairline, and weatherproof
   3. Physical and thermal isolation of glazing from framing members
   4. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances
   5. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible

C. Sunshade:
   1. Fabricate components for assembly using manufacturer’s standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

2.6 ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Finish for sunshades shall be **anodized aluminum, Class I clear (AA-M10C21A41 / AAMA 611)** to match curtain wall frame as shown in detail.
   2. All sunshade assemblies shall be finished to match Kawneer Permanodic® Color #14 Clear, unless otherwise noted.

PART 3 EXECUTION

3.1 EXAMINATION

A. With installer present, examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Proceed with installation only after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions. Refer to installation instructions of the compatible curtain wall or storefront system.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure non-movement joints.

5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight where shown on approved shop drawings and/or manufacturer's standard installation instructions.

B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

E. Coordinate exact sunshade alignment with glass and curtain wall layout as shown in architectural elevations and detail drawings.

F. Ensure alignment with adjacent sunshades mounted on metal panels to maintain continuous visual datum

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:
1. Protect installed product’s finish surfaces from damage during construction.
2. Protect aluminum sunshade system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants

C. Cleaning:
1. Repair or replace damaged installed products.
2. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.
3. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
4. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 107113

DIVISION

11

EQUIPMENT

SECTION 11 66 23 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following gymnasium equipment:

1. Basketball equipment.
2. Volleyball equipment.
3. Safety pads.

B. Related Sections include the following:

1. Division 03 Section 03 30 00 "Cast-in-Place Concrete" for installation of floor insert sleeves to be cast in concrete slabs and footings.
2. Division 05 Section 05 12 00 "Structural Steel Framing" for basketball goal supports.

1.3 morotDEFINITIONS

A. FIBA: International Basketball Federation (Federation Internationale de Basketball Amateur).

B. FIVB: International Volleyball Federation (Federation Internationale de Volleyball).

C. IBF: International Badminton Federation.

D. NAGWS: The National Association for Girls and Women in Sport.

E. NCAA: The National Collegiate Athletic Association.

F. NFHS: The National Federation of State High School Associations.

G. USAV: USA Volleyball.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.

B. Shop Drawings: For gymnasium equipment. Include plans, elevations, sections, details, attachments to other work, and the following:

1. Method of field assembly for removable equipment, connections, installation details, mountings, floor inserts, attachments to other work, and operational clearances.
2. Transport and storage accessories for removable equipment.

C. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, point reactions, and locations for attachment of gymnasium equipment to structure.

D. Coordination Drawings: Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finished flooring.

E. Samples for Initial Selection: For each type of gymnasium equipment indicated.

F. Samples for Verification: For the following products:

1. Basketball and volleyball Net: Full size.
2. Volleyball Floor Insert: Full-size unit.
3. Volleyball Post Standard: Full-size unit with net tensioner.
4. Pad Fabric: Not less than 3 inches square, with specified treatments applied. Mark face of material.

G. Product Certificates: For each type of gymnasium equipment, signed by product manufacturer.

H. Qualification Data: For Installer and professional engineer.

I. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

J. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products .

B. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.

C. Composite Wood Products: Made without urea formaldehyde.

D. All welding to be performed by personnel having passed Welder Qualification testing in accordance with American Welding Society (AWS) code D1.1 or higher. Manufacturer to provide certification and test results upon request.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide volleyball floor sleeves, covers and floor inserts in accordance with requirements of related trades that are responsible for installation. Do not deliver balance of athletic equipment until building is enclosed and other construction within gymnasium is substantially complete.

1.8 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.

B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gymnasium equipment which fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion, unless specifically stated in product descriptions.

B. Basketball Goal Warranty: Backstop support structures including clamps, fittings and tube.

1. Warranty Period: 25 years form date of Substantial Completion.

C. Basketball Backboard Warranty: Mounted on proprietary fittings.

1. Warranty Period: Lifetime of Building.

D. Goal Warranty:

1. Warranty Period: Three years

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extruded Bars, Profiles, and Tubes: ASTM B 221.
2. Cast Aluminum: ASTM B 179.
3. Flat Sheet: ASTM B 209.

B. Steel: Comply with the following:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
3. Steel Sheet: ASTM A 1011/A 1011M.

C. Support Cable: Manufacturer's standard galvanized steel aircraft cable with a breaking strength of 7000 lb. Provide fittings complying with cable manufacturer's written instructions for size, number, and method of installation.

D. Support Chain and Fittings: Grade 80 hardened alloy steel chain rated for overhead lifting, ASTM A 391/A 391M, with commercial-quality, hot-dip galvanized steel connectors and hangars.

E. Castings and Hangers: Malleable iron, ASTM A 47/A 47M, grade required for structural loading.

F. Softwood Plywood: DOC PS 1, exterior.

G. Particleboard: ANSI A208.1, made with adhesive containing no urea formaldehyde.

H. Equipment Wall-Mounting Board: Wood, transparent painted finish, size, and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.

I. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.

J. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

2.2 BASKETBALL EQUIPMENT

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Draper Inc./Hahn Enterprises or a comparable product by one of the following:

1. Arizona Courtlines, Inc.
2. Institutional Products, Inc.
3. Jaypro Sports, LLC.
4. Porter Athletic Equipment Company.

B. General: Provide equipment complying with requirements in FIBA's "FIBA Basketball Rule Book**."**

C. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.

2.3 BASKETBALL BACKSTOPS

A. Basis-of-Design: Draper EZ FOLD Model TF-20-B, ceiling-suspended and forward folding. All proprietary names reference Draper, Inc. and the above mentioned product.

B. Description: Galvanized steel backstop with galvanized steel tube frame support structure.

C. Support Structure: Tetrahedral triangle support structure ~~with hinge for retraction of backboard~~ and goal not more than 15-inches from ceiling, and with side braces laterally bracing main stem connecting no higher than 4-feet 6-inches above goal.

1. Main Stem: Minimum 6-inches OD, 11-ga.
2. Stem Cross-Member: Minimum 4-inches OD, 11-ga.
3. Side Braces: 2-1/4 inches
4. Hinge: Minimum 1-1/4 inches solid steel pin turning in minimum ½-inch steel plate hangars.

    a. Design Load: 25,000-lbs
    b. Safety Factor: 55:1

D. Backstop: Rectangular frame of 1-1/2 inches OD galvanized steel tubing with galvanized steel cross-bracing matching main members, tied to roof via 4-inch OD 11 ga. steel tubing anchor to roof with heavy steel support hangers; hanger supports to be rated for 20,000 lbs. The superstructure shall be designed with a minimum attachment point safety factor of 75:1.

E. Rear Brace: Folding, jackknife type, fully adjustable and telescoping, self-locking in the down position and constructed of 2-1/4 inches OD 14-ga. steel tubing nested in 2-1/2 inches OD 13-ga. steel tubing.

F. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from Manufacturer's full range.

    a. sa

2. Fabrication: Mitered ends of the frame extrusions fit with a flush, plated steel gusset type mounting bracket on all four corners.

    a. Incorporate keyhole slots for mounting the backboard to the support structure at standard mounting centers.

3. Goal-Mounting Structure: Heavy-duty, formed steel assembly, secured to the lower horizontal frame member with minimal connection to the glass section; provide rigid thru-connection between front and back mounting plates, unitizing structure. Provide neoprene cushion between mounting plate and glass. Provide mounting holes for goal and braces as per NCAA rules (BR-73, D-5).

G. Safety Padding: Steel track-reinforced mold formed foam, bolted on to back-board edge; mold forming process should form external protective skin.

1. Basis-of-Design: Model 5032--; Bolt-on, by Draper, Inc. All proprietary names reference the above mentioned product.
2. Color: As selected by Architect from manufacturer's full line.

H. Goal: 18-inches diameter, breakaway rim of 5/8-inches diameter steel rod, conforming with NCAA specifications, rigidly braced with die-cut steel welded to underside of rim, positioned 6-inches from face of backstop.

1. Basis-of-Design: Model A0576 breakaway goal by Draper, Inc. All proprietary names reference the above mentioned product.
2. Breakaway Rim: Goal shall be designed to withstand shock loads due to player interface. The rim shall deflect down when a static load of 230 pounds is applied, returning to the playing position once removed. Goal shall be set at factory for proper flex and rebound requirements.
3. Mounting: With zinc-plated, heavy-duty steel mounting plate with mounting holes centered to match conventional 5-inches x 5-inches or 5-inches x 4-inches backboard mounting holes.
4. Net Mounting: Twelve "no tie" net attachment clips, welded to rim.
5. Finish: Baked enamel or powder-coat.

    a. Color: As selected by Architect from Manufacturer's full range.

2.4 VOLLEYBALL EQUIPMENT

A. General: Provide ~~2~~ 1 complete systems with nets.

B. General: Provide equipment complying with requirements in FIVB's "Official Volleyball Rules."

C. Basis-of-Design Product: Subject to compliance with requirements, provide Model 500001 PVS-01 by Draper, Inc. All model numbers and propriety names key into the manufacturer of the basis for design. Alternatively, provide a comparable product by one of the following:

1. Arizona Courtlines, Inc.
2. Institutional Products, Inc.
3. Porter Athletic Equipment Company.
4. Schelde.
5. Sports Import/Senoh.

D. General: Provide equipment complying with requirements in FIVB's "Official Volleyball Rules and NAGWS's "NAGWS Volleyball Rulebook.

E. Description: Standards of schedule 80 aluminum pipe, fitted telescope fashion and adjustable, complying FIVB, USVBA, NCAA and NFSHSA requirements.

1. Standards: 2-7/8 inches OD in 3-½ inches OD, with wall thicknesses of .276-inches and .300-inches respectively. Assemble to allow extension between 73-inches and 100-inches, in one-inch increments.
2. Tensioning: 4-inch pulley at each post, with power winch and matching adjustable cable anchor collar on opposite poles. Winch to be furnished with heavy-duty, self-locking worm gear mechanism, collapsing handle, and 2-inches nylon strapping.

F. Net: 32 feet long and as follows; 1 per pair of paired post standards:

1. Width and Mesh: 36 inches with 4-1/2-inch-square mesh made of black polyester string.

a. Hem Band Edges: White, 2-inch- wide top binding; black, 1-inch- wide bottom and side bindings; tie offs at top and bottom of each side end of net; and 1/4-inch-diameter rope, at least 42 feet long, threaded through top hem of binding.

2. Dowels: Not less than 1/2-inch-diameter fiberglass or 1-inch-diameter wood. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
3. Net Antennas: 3/8-inch-diameter, high-tensile-strength, extruded fiberglass or plastic rods, 72 inches long, extending above top hem band of net, with alternating white and red bands according to competition rules. Provide two antennas per net.

a. Clamps: Designed to secure antenna to top and bottom of net.

4. Boundary Tape Markers: 2-inch- wide white strip with sleeve for securing net antenna, secured to net top and bottom with hook-and-loop attachment. Provide two tape markers per net for marking court boundaries.

G. Floor Insert: Aluminum floor plate; and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, not less than 9 inches long to securely anchor pipe sleeve below finished floor in concrete footing; with anchors designed for securing floor insert to floor substrate indicated; one per post standard.

1. Floor Plate: Self-locking, hinged access cover, designed to be flush with adjacent flooring. Provide two tool(s) for unlocking access covers.

H. Storage Cart: Manufacturer's standard wheeled unit designed for transporting and storing volleyball equipment and passing through 36-inch- wide or wider door openings. Fabricate units of welded steel tubing with heavy-duty casters, including not less than two swivel casters. Fabricate wheels from materials that will not damage or mark floors; number of units as required to provide transport and storage for specified equipment.

I. Judges' Stands: Provide manufacturer's standard adjustable-height units designed to be freestanding, folding for storage. Fabricate units of welded steel tubing with finish and color to match post standards.

J. Safety Pads: Comply with NCAA and NFHS requirements. Provide pads consisting of not less than 1-inch-thick, manufacturer's standard foam filler covered by , manufacturer's standard Insert other fabric cover; with fire-test-response characteristics indicated, and lined with fire-retardant liner. Provide pads with hook-and-loop closure or attachments for the following components:

1. Post Standards: Wraparound style, designed to totally enclose each standard to a height of not less than 66 inches; 1 per post.
2. Net Lines: Four per net.
3. Fabric Cover Flame-Resistance Ratings: Passes NFPA 701.
4. Fabric Color: As selected by Architect from manufacturer's full range.

2.5 WALL SAFETY PADS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arizona Courtlines, Inc.
2. Draper Inc.
3. Institutional Products, Inc.
4. Jaypro Sports, LLC.
5. Porter Athletic Equipment Company.

B. Safety Pad Surface-Burning Characteristics: ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Pad Coverings: Provide safety pad fabric covering fabricated from puncture- and tear-resistant, not less than 14-oz./sq. yd PVC-coated polyester or nylon-reinforced PVC fabric treated with fungicide for mildew resistance; with surface-burning characteristics indicated, and lined with fire-retardant liner.

D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.

1. Backer Board: Not less than 3/8-inch- thick plywood, mat formed, or composite panel.
2. Fill: Multiple-impact-resistant foam not less than 2-inch- thick bonded polyurethane, 6.0-lb/cu. ft. density.
3. Size: Each panel section, 24 inches wide by not less than 72 inches long.
4. Number of Panel Sections: As indicated modular panel sections.
5. Installation Method: 1-inch top and bottom fabric attachment flange with exposed fasteners.
6. Fabric Covering Color(s): As selected by Architect from manufacturer's full range for two color(s).
7. Graphics: Custom graphics as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, and other conditions affecting performance.

1. Verify critical dimensions.
2. Examine supporting structure and subgrades, subfloors and footings below finished floor.
3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly, where required.

B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.

C. Permanently Placed Gymnasium Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.

1. Floor Insert Location: Coordinate location with application of game lines and markers, and core drill floor for inserts after game lines have been applied.
2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and type of floor plate.
3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

D. Floor Insert Setting: Position sleeve in oversized, recessed voids in concrete slabs. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions. Protect portion of sleeve above subfloor and footing from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.

E. Wall Safety Pads: Mount with bottom edge at 4 inches above finished floor.

F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.

G. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration has been approved by Owner, and store units in location indicated on Drawings.

3.3 ADJUSTING

A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment. Refer to Division 01 Section 01 79 00 "Demonstration and Training."

END OF SECTION 11 66 23

DIVISION

12

FURNISHINGS

SECTION 12 25 13 – WINDOW ROLLER SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roller shades, motorized operation and accessories.
   1. Intelligent encoded electronic drive system.
   2. Motor controls, interfaces, and accessories.
   3. PoE motorized, sunscreen and blackout roller shades as applicable. Work includes local, group and master control systems for shade operation with addressable, DC motors, IP motor hubs, wall controllers, sensors, IP gateways, SAC Shade Controllers and associated software system.

B. Shade fabric.

1.2 RELATED SECTIONS

A. Section 06 10 00 - Rough Carpentry: Wood blocking and grounds for mounting roller shades and accessories.

B. Section 09 21 16 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.

C. Division 26 - Electrical: Electric service for motor controls. Electrical and low voltage requirements, internal communication, data transfer, and connection to the Internet and local PoE switches as required.

1.3 REFERENCES

A. ASTM International (ASTM):
   1. ASTM G21 and E 2180 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   2. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

C. Underwriters Laboratories (UL):
   1. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

D. Window Covering Manufacturers Association (WCMA):
   1. WCMA A100.1 - Safety of Window Covering Products; 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: One week prior to commencing work related to this section. Require attendance of all affected installers.

C. Sequencing:
1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 01 33 00 - for submittal procedures.

B. Bid Submittal: Information Required with Submittal of Bid: In order to evaluate proposals for integrated lighting control and window shade systems, the Architect requires the following information be submitted prior to the award of the system.
1. Bid proposal shall be accompanied with a document that notes all deviations from these specifications on a line-by-line basis.
2. If using PoE motors, bid shall confirm that PoE motor roller shade and all related controls shall be integrated into a compatible control system as specified herein.
3. If integrating into BAS/BMS system, bid shall include separate line items listing the control/interface components required for building automation systems and building management systems (BAS/BMS), daylighting, audiovisual, and/or central integration systems. Roller shade controls manufacturer shall list all components included in their bid and shall include a letter stating that they shall be financially responsible for any change orders and/or back charges required by the BAS/BMS, audiovisual, or lighting control systems contractors to interface with the motorized roller shade system.

C. Product Data: Manufacturer's catalog pages and data sheets for products specified including materials, finishes, dimensions, profiles, mountings, and accessories.
1. Preparation instructions and recommendations.
2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes , accessories, and operating instructions.
3. Storage and handling requirements and recommendations.
4. Mounting details and installation methods.
5. Manufacturer's Instructions: Include storage, handling, protection, examination, preparation, and installation.
6. Project Record Documents: Record actual locations of control system components and show interconnecting wiring.
7. Motorized Shades: Power requirements. Typical wiring diagrams including integration of EDU controllers with building management system, audiovisual and lighting control systems as applicable.
    a. If using PoE motors, include integration of PoE motor hubs, shade motors, wall controllers, software programming, ability to integrate with building management system, audiovisual and lighting control systems as applicable.

D. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.

1. Prepare shop drawings using base sheets provided electronically by the Architect.
2. Prepare control wiring diagrams based on zones, switching and operational requirements provided by the Architect in electronic format.
3. Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
4. Provide location plan showing all motor locations, switch locations and control zones as per the performance requirements of the specifications. All switches, sensors and other control accessories must clearly be shown and called out in a bill of materials.
5. Provide elevation drawings showing shade band layout. Indicate any necessary seam or batten locations and align with horizontal mullions where possible.

A. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

B. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.
6. Shadecloth Sample: Mark face of material to indicate interior faces.
   a. Test reports indicating compliance with specified fabric properties.
   b. Verification Samples: 6 inches (150 mm) square, representing actual materials, color and pattern.

C. Warranty: Provide manufacturer's warranty documents as specified in this Section.

1.6 QUALITY ASSURANCE

A. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

B. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section.

C. Installer for Roller Shade System - Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
1. Requirements for Roller Shade Installer/Contractor:
   a. Roller Shade Hardware, shade fabric, motor, and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.
   b. Roller Shade Installer/Contractor shall list all components and systems included in their bid, including but not limited to, the prime manufacturer of the motor control and automated equipment and shall be financially responsible for any change orders and/or back charges required by the BMS, AV, or Lighting Control Systems contractors to interface with the automatic solar tracking system and the motorized roller shade system.
   c. If using PoE motors, installer for roller shade system shall be trained and certified by all manufacturers involved including IP gateway, PoE motor hubs, COAP protocol wall controllers, EnOcean enabled keypads and sensors, UPoE+ switch and be capable of complete deployment of controls, software and hardware.

D. Product Listing Organization Qualifications: Organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

E. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

F. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.

G. Requirements for Electronic Hardware, Controls, and Switches: Roller shade hardware, shade fabric, EDU (Electronic Drive Unit), and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.
   1. If using PoE motors, roller shade hardware, shade fabric, PoE motor hub, DC shade motor, software and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.

H. ShadeCloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC9644 and ATCC9645, and E2180.

I. ShadeCloth Cleanability and Disinfecting: ShadeCloth must meet cleanability and disinfecting requirements via 3rd party testing to comply with BIFMA HCF 8.1-2014 standards using chemical solutions compliant with EPA guidelines for use against COVID-19.

J. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified. Initial submittals, which do not include the Environmental Certification will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.

K. Third Party Evaluation: Provide documentation stating the shade cloth has undergone third party evaluation for all chemical inputs, down to a scale of 100 parts per million, that have been evaluated for human and environmental safety. Identify any and all inputs, which are known to be carcinogenic, mutagenic, teratogenic, reproductively toxic, or endocrine disrupting. Also identify items that are toxic to aquatic systems, contain heavy metals, or organohalogens. The material shall contain no inputs that are known problems to human or environmental health per the above major criteria, except for an input that is required to meet local fire codes.

L. Recycling Characteristics: Provide documentation that the shade cloth can, and is part of a closed loop of perpetual use and not be required to be down cycled, incinerated or otherwise thrown away. Scrap material can be sent back to the mill for reprocessing and recycling into the same quality yarn and woven into new material, without down cycling. Certify that this process is currently underway and will be utilized for this project.

M. Perpetual Use Certification: Certify that at the end of the useful life of the shade cloth, that the material can be sent back to the manufacturer for recapture as part of a closed loop of perpetual use and that the material can and will be reconstituted into new yarn, for weaving into new shade cloth. Provide information on each shade band indicating that the shade band can be sent back to the manufacturer for this purpose.

N. Turn-Key Single-Source Responsibility for Wiring Motorized Interior Roller Shades: To control the responsibility for performance of motorized roller shade systems, assign the design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single manufacturer and their authorized installer/dealer. The Architect will not produce a set of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage), shall be provided by the general contractor ("GC"), not roller shade installer/dealer (Window Coverings Subcontractor or "WC"), in accordance with the requirements provided by the manufacturer. Coordinate the following with the roller shade installer/dealer:
   1. GC shall provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings.
   2. GC shall coordinate with requirements of WC, before inaccessible areas are constructed.
   3. GC shall run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated by WC.
   4. GC shall provide and run all line voltage (from the terminating points) to the motor controllers. WC shall wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/ control locations designated by the Architect. All above-ceiling and concealed wiring shall be plenum-rated, or installed in conduit (provided by Electrical Subcontractor), as required by the electrical code having jurisdiction.
   5. GC shall provide conduit with pull wire in all areas, which might not be accessible to roller shade contractor due to building design, equipment location or schedule.
   6. GC shall provide wiring and labor cost difference between power requirements for AC and DC motor options in overall cost comparison of AC and DC motorized shades.

1.7 MOCK-UP

A. Provide a mock-up of one roller shade assembly for evaluation of mounting, appearance and accessories.
   1. Locate mock-up in window designated by Architect.
   2. Mockup Size: Full size.
   3. Mockup Size (WxH): 3 x 3 feet (0.94 x 0.94 m) minimum.
   4. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
   5. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
   6. Do not proceed with remaining work until, mock-up is accepted by Architect.
   7. Retain mock-up during construction as a standard for comparison with completed work.
   8. Do not alter or remove mock-up until work is completed or removal is authorized.
   9. Full-sized mock-up may become part of the final installation.
   10. Full-sized mock-up will become the property of the Owner to be used for spare parts.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in Window Treatment Schedule.

B. Store and handle products per manufacturer's recommendations.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Power and control wiring shall be complete and certified, fully operational with uninterrupted communication on the lines and minimal noise certified by a commissioning agent specified in other sections.
   1. 485, ICON, Lonmark and Dry Contract Network: Noise on the line not to exceed shade manufacturer's limits.

1.10 WARRANTY

A. Roller Shade Hardware Warranty: Manufacturer's standard non-depreciating, transferrable warranty for interior shading.
   1. Shade Hardware - 10 years unless otherwise indicated:
      a. ElectroShade with ThermoVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25-years.
   2. All Mecho Shadecloth: Manufacturer's standard 25-year warranty.
   3. Roller Shade Motors, Motor Control Systems, and Accessories: Manufacturer's standard non-depreciating 10-year warranty for AC motors and controls and 10-year warranty for DC motors, power panels and controls. Roller shade low voltage PoE motor and associated wall controller, IDF, plenum located PoE hubs and associated control systems must have manufacturer’s minimum, non-depreciating 10-year warranty. Somfy motors and controls standard 5-year warranty. NuLEDs SpiceBox, keypads, sensors and associated lighting products standard 5-year warranty.
   4. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owners responsibility.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer for Window Shade Control System as basis of design, performance and warranty: Mecho, which is located at: 42-03 35th St.; Long Island City, NY 11101; ASD Tel: 718-729-2020; Fax: 718-729-2941; Email: marketing@mechoshade.com; Web: www.mechoshade.com. For your local Mecho rep: https://www.mechoshade.com/find-a-rep/

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 APPLICATIONS/SCOPE

A. Roller Shade Schedule:
   1. Shade Type 9: C-Channel Fixed or Fixed Frame sunscreen with room darkening opaque or sunscreen shade cloth, and related frame or channel mounting systems and accessories as indicated on drawings.
   2. ADA Compliance: All spaces requiring full ADA compliance to be motorized with an accessible wall switch.

2.3 ROLLER SHADES, MOTORIZED OPERATION AND ACCESSORIES

A. Shade System; General:
   1. Motorized Shades: Comply with NFPA 70.
   2. Components capable of being removed or adjusted without removing mounted shade brackets or cassette support channel.
   3. Operates smoothly when raising or lowering shades.
   4. Cradle-to-Cradle certified and listed in C2C (DIR).
   5. Electrical Components: Listed, classified, and labeled as suitable for intended purpose. Test as total system. Individual component testing is acceptable.
      a. Components: FCC compliant where applicable.

B. Basis of Design: ElectroShade with WhisperShade IQ2 EDU. As manufactured by MechoShade Systems LLC. Motor operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   1. Voltage: 120 VAC
   2. Voltage: 24 VDC
      a. Optional PoE
   3. Description: Single roller.
   4. Drop Position: Regular roll.
   5. Mounting: Ceiling mounted.
   6. Mounting: Recess mounted in ceiling pocket.
   7. Mounting: Wall mounted.
   8. Mounting: Window jamb mounted.
   9. Mounting: _____.
   10. Size: (WxH): _____.
   11. Size: As indicated on drawings.
   12. Fabric: As indicated under Shade Fabric article.
   13. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade. Plastic components without use of steel angle construction do not meet the intent of this specification and shall not be accepted. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.
      b. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
      c. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).
      d. All bands within a single motor group shall be aligned within ¼ inch.
      e. Multiple Shade Operation: Provide hardware as necessary to operate more than one shade using a single motor.
   14. Roller Tubes:
      a. Material: Extruded aluminum.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without

removing roller tube from brackets or inserting spline from the side of the roller tube.

15. Hembars: Designed to maintain bottom of shade straight and flat.
    a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
    b. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
16. Accessories:
    a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.
        1) Finish: Baked enamel.
        2) Capable of installation across two or more shade bands in one piece.
        3) Color: White.
        4) Profile: Square.
        5) Configuration: Captured, fascia stops at captured bracket end.
        6) Designed to accommodate installation of motor control and wiring accessories within pocket including, but not limited to, line voltage disconnect modular connector, MechoNet Wireless Controller, IQ2 Dual Splitter, and non-plenum rated daisy chain wiring.

2.4 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

A. Electronic Drive Unit (EDU) System General Requirements:
1. A UL 325 listed solution.
    a. Component certification in lieu of system testing is not acceptable.
2. Listing Label and Motor Rating: To be visible for inspection without dismounting of shade assembly to remove motor or EDU from shade roller tube.
3. Size and Configuration: As recommended by manufacturer for type, size, and arrangement of shades.
4. Conceal EDU inside shade roller tube.
5. EDU Rated Speed: The same nominal speed for shades in the same room.
6. Hanging Weight of Shade Band: 80 percent of rated lifting capacity of shade EDU and tube assembly.
7. Capable of upgrading firmware from anywhere on network without touching the motor.

B. Low Voltage EDU (24 VDC):
1. Basis of Design: MechoShade Systems LLC; WhisperShade IQ2-DC System. Tubular, asynchronous, integral DC motor. 24 VDC; temperature Class B, thermally-protected, totally enclosed, maintenance-free. Powered by low voltage power supply connection equipped with disconnect plug assembly furnished with EDU.
2. Audible Noise: 38 dBA measured 3 ft (914 mm) from motor unit, depending on motor torque.
3. Nominal Speed: 10 to 28 RPM. Configurable. Speed managed such that it does not vary due to load/lift capacity.
4. Low voltage power supply for powering external accessories connected to either the dry contact or network port.
    a. Products that require accessories to be powered by a plug-in or externally-supplied power supply are not acceptable.
5. Wireless Controls: Optional built-in two-way wireless EnOcean controls through iQ3-DC-RF motor.
6. Override Mode: Place motor into Override Mode when local switch commands shade to new position.
    a. Local switch command sources:

1) Keypad connected to EDU dry contact inputs.
2) Third-party system connected to EDU dry contact inputs.
3) Network keypad or other device that serially communicates with EDU and configured to issue override commands as if it were a local switch connected to EDU dry contact inputs.

b. Entering Override Mode: Monitor and log positioning commands from automation devices. Do not act until exiting Override Mode.
c. Return from Override Mode: Position shade to last commanded position in log.
d. Automated Return from Override Mode:
1) Override Return Timer: When Override Mode is entered by changing shade position with local switch as described above, Enable override return timer to make these changes temporary such that automation can regain control of shade after configurable time duration (default of 60 minutes).
2) Pocket temperature sensor integral to EDU to track pocket temperature.
a) When shade is in Override Mode and Heat Gain Sensing is Enabled: Sensor determines when direct sunlight and associated solar heat gain has left the window.
1) When this condition occurs, after the shade has been overridden to cover the window, EDU to return from Override Mode if Override Return Timer has not done so already in order for automation controllers to once again optimize shade position for exposure to daylight.

7. Preventative Maintenance:
a. Internally monitor important operating parameters to ensure motor and its shade assembly are functioning properly.
b. Performance Degradation: Provide visual indication via feedback LED and communicate warnings on repetitive basis through its serial port.
c. Warning Conditions: Logged and queryable. Allow sending of multiple warnings until condition is acknowledged.
d. Stop shade rotation for parameters of critical concern until reset by trained technician after being serviced.
e. Devices capable of receiving warnings include SolarTrac automated solar-evaluation control system.
f. Tracked Parameters to include:
1) Operating life (cycles, hours).
2) Pocket temperature.
3) Internal motor temperature.
4) Vibration.
5) Stall.
6) Power reset.
7) Maintenance Mode.
8) Speed regulation.
9) Position targeting.
10) Movement without command.
11) One Bus availability.
g. Detectable Potential Warning Conditions to Include:
1) Assembly vibration/bearing wear warning.
2) Tube/shade assembly drop.
3) Fabric hung-up/telescoping.
4) Motor mount warning.
5) Lifecycle replacement warning.

6) Brake/limit failure.
7) Network warning.
8) Motor internal temperature warning.
9) Pocket temperature warning.

C. Low Voltage EDU by Mecho to operate on Power Over Ethernet (PoE).
1. Intelligent motors controlled and monitored via IP digital network
2. IP Gateway must be supplied to work with overall control system
3. All power delivered to motor directly from UPoE+ switch with minimum of 90 watt output on every port (switch supplied and supported by others)
4. UPoE+ (90W) Shade Controller and MechoNet Hub • Supports IEEE 802.3af, 802.3at, 802.3bt Type 3 or Type 4 PoE Network Switches with LLDP. (PoE, PoE+, UPoE, UPoE+ compliant.
5. PoE port power ratios by supporting simultaneous group control of multiple IQ2-DC motors over 1 PoE hub.
6. Single network solution across the building for windows of all sizes using both AC and DC motorized shades. PoE Hub controls unlimited line voltage AC-powered WhisperShade IQ2 and IQ2+ motorized shades.
7. PoE Hub provides access to MechoNet Wireless sensors and keypads through MechoNet MWC+ controllers.
8. Cisco DNA / Smart Building Solutions Partner - Employs CoAP (Constrained Application Protocol) messaging and MUD (Manufacturer Usage Description) for secure, open communication across sub-systems.
9. SolarTrac 4.0 compliant for industry leading automation strategy efficacy and flexibile
10. DC motor according to standards ISO3741 NF 31022 in dBA ref 1pW at nominal Torque without end product < 38 dBA
11. Maximum current draw for each shade LV DC Motor of 1.5 Amps at 24VDC.
12. PoE LV DC motor rated speed is 10-25rpm Adjustable
13. Temperature Working Range 32°F to 140°F (0°C to 60°C) (Interior use only)
14. Insulation Class: Class 111
15. Wiring to be all low voltage cat6 to IP Hub from UPoE switch
16. Index Protection Rating: IP 20 (interior)
17. UL Listed FCC and CE compliant

D. PoE LV DC Motor System: (software, two-way communication): Specifications and design are based on Intelligent PoE motor control system from Mecho. PoE performance criteria:
1. PoE LV DC Motor shall support two methods of control
   a. Local override wall control for in room manipulation
      1) Controller to work on COAP protocol
      2) User interface via GUI to manage controllers to shades
   b. Network Control
      1) PoE Motor shall be equipped with a bi-directional IP network communication capability to support operation of individual or groups of shades over a common IP network via an API.
2. Upper and lower stopping points (operating limits) of shade bands shall be programmed into PoE LV DC motors using either a handheld removable program module or MechoNet Programming software.
3. Alignment Positions: Each PoE LV DC motor shall support a minimum of 133 repeatable and precisely aligned shade positions (including limits and presets).
   a. All shades on the same switch circuit or with the same network group address with the same opening height shall align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.

b. Shades of differing heights shall have capability for custom, aligned intermediate stop positions when traveling from any position, up or down.
c. Alignment of shades mechanically aligned on the same PoE LV DC motor shall not exceed +/- 0.125 inches (3.175mm) when commanded to the same alignment position.
d. Alignment of shades on adjacent PoE LV DC motors shall not exceed +/- 0.25" inches (6.35mm) when commanded to the same alignment position.
e. Local on wall controller:
    1) Upon setting the limits for the shade, PoE LV DC motor preset positions shall be capable of IP control to default to 25%, 50% and 75% of the shade travel in addition to standard up and down
    2) These positions shall be capable of being customized.
f. Network Presets: A minimum of 10 customizable preset positions shall be accessible via network commands.
    1) Upon setting the limits PoE LV DC motor these preset positions shall automatically default to the lower limit unless customized elsewhere.
    2) These positions shall be capable of being customized and grouped using the control software.

4. PoE LV DC Motor Wiring
    a. One unshielded Twisted CAT-6 or higher from every motor hub location to floor IDF / IT room or as per wiring diagram to plenum rated Cisco switch in zone.
    b. Each wire to meet TIA-568B Standard with Plastic RJ-45 Connectors
    c. Wire to be plenum rated where required by code
    d. Every wire to be machine labeled at each end with a unique identifier.
    e. LV DC Shade motor end to have 12" whip rolled up to allow for shade installation
    f. Closet end to be punched down into patch panel (rack location and style to be coordinated in field by GC or end user)
    g. Every wire to be certified using Fluke DSX cable analyzer or comparable equipment.
    h. Max Distance from Switch to PoE Motor Hub is 225' with 2x14AWG/3x22AWG cable.

E. Modes of Operation:
1. Uniform Mode: Shades move to defined intermediate stop positions in order to maintain aesthetic uniformity.
2. Normal Mode: Shades move to defined intermediate stop positions and any position between defined upper and lower limits.
3. Maintenance Mode: Prevents shade from moving via dry contact or network control commands mode has been cleared/disabled.

F. Control Methods: Local isolated dry contact input and network control.
1. Local Isolated Dry Contact Inputs:
    a. Local switch control, third party system integration without separate interface.
    b. Moving EDU/shade to upper and lower limits and local switch preset positions.
    c. Configuration of upper and lower limits, custom presets, and key modes of operation without a PC or microprocessor-based tools.
    d. Configuration under protected sequences to prevent changes by casual user.
    e. Switch Personalities: Configuration of dry contact control port over network such that any type of dry contact keypad/third-party interface and actuation

methodology (maintained and/or momentary actuation) can be used to operate shade.

f. Dry Contact Control Connection Options to Include:
   1) One-button.
   2) Two-button.
   3) Three-button. Able to support configuring limits, presets, and key operating modes (default).
   4) Three-button. No configuration capability to prevent accidental changes in settings.

2. Network Control:
   a. Bi-directional network communication to enable commanding operation of large groups of shades over a common backbone.
   b. Each EDU:
      1) Support eight network addresses capable of being employed for various levels of group control.
      2) Dry Contact Ports: Assigned its own local switch address which can be matched by other EDUs within eight network addresses in order to support group control when dry contact commands are received.
         a) The EDU receiving dry contact commands may or may not be configured to operate based on commands coming through its own dry contact input port.
      3) To have an independent unique identifier address (UID) enabling EDU to be independently controlled and configured over network via handheld configurator and/or PC controller.
   c. Network Communication Card: Integral with tubular EDU assembly.
   d. Support configuration of upper and lower limits using either a handheld removable program module/configurator or a local switch.
   e. Support configuration of addresses using a handheld removable program module/configurator.

G. Alignment Positions:
   1. Repeatable and precisely aligned shade positions and limits.
      a. Support positioning commands from 0 to 100 percent in 1 percent increments.
      b. Customizable Presets: 32.
      c. Include three intermediate dry contact presets
   2. Shades on same switch circuit or same network group address with same opening height, to align at each intermediate stopping position when traveling from any position, up or down.
   3. Shades of differing heights: Capable of custom, aligned intermediate stop positions when traveling from any position, up or down.
   4. Alignment of shade bands mechanically aligned on same EDU: Plus or minus 0.125 inch (3 mm).
   5. Alignment of standard shades on adjacent EDUs: Plus or minus 0.25 inch (6 mm) when commanded to same alignment position.

H. Local Switch Presets:
   1. Minimum of three customizable preset positions accessible over the local dry contact control inputs and over the network connection.
   2. Preset positions: Customizable to any position between and including defined upper and lower limits (initially defaults to 25, 50, and 75 percent of shade travel).
   3. Configuration of Custom Preset Positions: A handheld removable program module/configurator or a local switch.

I. Network Presets:
   1. Minimum of 32 customizable preset positions (including the three local switch presets) accessible via network commands.
   2. Preset positions: Customizable to any position between and including defined upper and lower limits (initially defaults to defined lower limit).
   3. Configuration of Custom Preset Positions: A handheld removable program module/configurator or a local switch.

2.5 MOTOR CONTROLS, INTERFACES, AND ACCESSORIES

A. Unless indicated to be excluded, provide required equipment as necessary for a complete operating system providing the control intent specified. Provide components and connections necessary to interface with other systems as indicated.

B. Digital Network Controls:
   1. Basis of Design: MechoShade Systems LLC; MechoNet. Low-voltage network utilizes standard Category 5/6 UTP cable; maximum of 4,000 feet (1,219 m), 250 nodes.
   2. Reprogram control without requiring wiring modifications.
   3. Ten-year non-volatile power failure memory for system configuration settings.
   4. Network Interface Components:
      a. MechoNet Network Interface; MNI Series: Four configurable motor/EDU ports (models available for RJ45 or terminal block wiring); four configurable switch ports; one infrared (IR) remote control port; one configurable serial port for RS232/RS485 communication.
      b. IQ2 Dual Splitter: Two motor/EDU ports; two switch ports.
      c. IQ/MLC2 Motor Group Controller: Four ports for line-voltage standard (non-intelligent) motors (120 or 230 VAC; 600 W, 1/4 HP maximum).
      d. IQ Gateway; one for each floor where controlling across multiple floors.

C. MechoNet User App Kit – App-Based Motor Control Accessory
   1. Description**:** Provide and install the MechoNet™ User App Kit for app-based control of Mecho ElectroShade® iQ™ motorized shading systems. This kit shall integrate MechoNet+ motors into a unified control platform utilizing the Bond Bridge Pro and MechoNet™ Motor Hub.
   2. Components**:**
      a. Bond Bridge Pro Wi-Fi/Ethernet device
      b. MechoNet™ Motor Hub with Ethernet-to-MechoNet+ routing
      c. MechoNet+ Terminator and RJ45 T-Connector
      d. Low-voltage MechoNet+ cables (24" and 30"
      e. Optional Sidekick remote for additional wireless control
   3. Functional Requirements:
      a. Provide app-based setup and configuration using the Bond Home app on iOS or Android.
      b. Enable control of up to 50 MechoNet+ motors per kit (multiple kits required for larger groups).
      c. Support scheduling (including astronomical), preset positions, scene-based control, and group shade movement.
      d. Enable seamless communication via secure protocols for integration with building control systems.
      e. Include LED indicators for real-time status and installation feedback.
      f. Provide support for ElectroShade® iQ2+, iQ2-DC, iQ3-DC, and iQ3-DC-RF motors.

g. Mounting hardware to support wall, ceiling, or backing board installations as required.

4. Connectivity Requirements:
   a. Bond Bridge Pro must connect to a 2.4 GHz Wi-Fi network.
   b. Device and smartphone must be on the same network during setup.
   c. Not compatible with WPA-Enterprise or captive portal networks.
   d. Confirm SSID and network readiness with client prior to installation.
5. Notes:
   a. Kit must comply with UL4200A safety standards.
   b. Handle components using proper electrostatic discharge (ESD) precautions.
   c. Installer to coordinate motor addressing and app configuration using MPS prior to commissioning.

2.6 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill Opening from Head to Sill: 1/2 inch (13 mm) space between bottom bar and window sill.
2. Vertical Dimensions: Fill Opening from Head to Sill: 1/2 inch (13 mm) space between bottom bar and finished floor.
3. Vertical Dimensions: Fill Opening from Head to Sill: 1/2 inch (13 mm) space between bottom bar and _____.
4. Vertical Dimensions: Fill Opening from Head to Sill (inch/mm): _____space between bottom bar and window sill.
5. Vertical Dimensions: Fill Opening from Head to Sill (inch/mm): _____space between bottom bar and finished floor.
6. Vertical Dimensions: Fill Opening from Head to Sill (inch/mm): _____space between bottom bar and _____.
7. Horizontal Dimensions: Inside Mounting.
   a. Fill openings from jamb to jamb. No light gap.
   b. Symmetrical Light Gaps on Both Sides of Shade: 3/4 inch (19.05 mm) total.
   c. Symmetrical Light Gaps on Both Sides of Shade (inch/mm): _____ total.
   d. Symmetrical Light Gaps on Both Sides of Shade (inch/mm): As detailed on the Drawings.
8. Horizontal Dimensions: Outside mounting.
   a. Cover window frames, trim, and casings completely.
   b. Extend shades beyond jambs on each side: 2 inches (50 mm).
   c. Extend shades beyond jambs on each side (inch/mm): _____.
   d. Extend shades beyond jambs on each side (inch/mm): As detailed on the Drawings.

C. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.

2.7 SHADE FABRIC

A. Basis of Design: Shade fabric as manufactured by MechoShade Systems LLC.
1. Solar Shadecloths:
   a. Fabric: Soho: 1100 series. 1 percent open. 2 x 2 basket-weave pattern of fine yarn PVC and polyester blend, also 126 inches (3200 mm) wide.
      1) NRC Rating: 0.60.

2) SAA Rating: 0.64.
3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

b. Fabric: Soho: 1600 series. 3 percent open. 2 x 2 basket-weave pattern of fine yarn PVC and polyester blend, also 126 inches (3200 mm) wide.
1) NRC Rating: 0.25.
2) SAA Rating: 0.29.
3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

c. Fabric: Soho: 1900 series. 5 percent open. 2 x 2 basket-weave pattern of fine yarn, PVC and polyester blend, also 126 inches (3200 mm) wide.
1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
3) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

d. Fabric: Soho Elavate: 1180 series. 1 percent open. 2 x 2 basket-weave pattern of fine yarn PVC and polyester blend with ProTX2, also 126 inches (3200 mm) wide.
1) EPA Registered Claims:
a) Kills 99.99% of bacteria in 10 minutes, such as Staphylococcus aureus and Psudomonas aeruginosa, on a continuous basis.
b) Reduces risk of cross-contamination from bacteria between treated surfaces.
c) Effective against 99.99% Gram-Negative and Gram-Positive bacteria.
d) Continuously self-disinfecting, bacteriostatic, hypoallergenic, self-cleaning, eliminates 99.99% of germs.
e) Inhibits the growth of odor on the fabric caused by bacteria.
f) Non-leaching.
g) Has a 5-log kill rate in 10 minutes.
2) NRC Rating: 0.40.
3) SAA Rating: 0.44.
4) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
5) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.

6) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

e. Fabric: Soho Elavate: 1680 series. 3 percent open. 2 x 2 basket-weave pattern of fine yarn PVC and polyester blend with ProTX2, also 126 inches (3200 mm) wide.
   1) EPA Registered Claims:
      a) Kills 99.99% of bacteria in 10 minutes, such as Staphylococcus aureus and Psudomonas aeruginosa, on a continuous basis.
      b) Reduces risk of cross-contamination from bacteria between treated surfaces.
      c) Effective against 99.99% Gram-Negative and Gram-Positive bacteria.
      d) Continuously self-disinfecting, bacteriostatic, hypoallergenic, self-cleaning, eliminates 99.99% of germs.
      e) Inhibits the growth of odor on the fabric caused by bacteria.
      f) Non-leaching.
      g) Has a 5-log kill rate in 10 minutes.
   2) NRC Rating: 0.30.
   3) SAA Rating: 0.31.
   4) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   5) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   6) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

f. Fabric: ThermoVeil: 0900 series. 0 to 1 percent visually translucent extra-dense linear weave pattern.
   1) NRC Rating: 0.30.
   2) SAA Rating: 0.32.
   3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

g. Fabric: ThermoVeil: 1000 series. 2 to 3 percent open, dense linear-weave pattern.
   1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.

h. Fabric: ThermoVeil: 1300 series. 5 percent open, 2 by 2 dense basket-weave pattern, also 126 inches (3200 mm) wide.
   1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).

2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
3) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

i. Fabric: ThermoVeil: 1500 series. 3 percent open 2 by 2 dense basket-weave pattern, also 126 inches (3200 mm) wide.
1) NRC Rating: 0.25.
2) SAA Rating: 0.28.
3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

j. Fabric: ThermoVeil: 1700 series. 1 percent open, 2 by 2 dense basket-weave pattern, also 126 inches (3200 mm) wide.
1) NRC Rating: 0.65
2) SAA Rating: 0.65.
3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

k. Fabric: ThermoVeil: 2100 series. 10 percent open 2 by 2 open basket-weave pattern.
1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
3) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

l. Fabric: EcoVeil: 1350 series. TPO Cradle to Cradle Certified, fabric, non-PVC, 1 X 1, basket-weave pattern at 5 percent open, also 126 inches (3200 mm) wide.
1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
3) Cradle to Cradle Material Health Certificate:
a) Achievement Level: Bronze.
4) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment

(LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

m. Fabric: EcoVeil: 1550 series. TPO fabric, Cradle to Cradle Certified, non-PVC, 1 X 1, basket-weave pattern at 3 percent open, also 126 inches (3200 mm) wide.
   1) NRC Rating: 0.35.
   2) SAA Rating: 0.38.
   3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   5) Cradle to Cradle Material Health Certificate:
      a) Achievement Level: Bronze.
   6) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

n. Fabric: EcoVeil: 1750 series. TPO fabric, Cradle to Cradle Certified, non-PVC, 1 X 1, basket-weave pattern at 1 percent open, also 126 inches (3200 mm) wide.
   1) NRC Rating: 0.65.
   2) SAA Rating: 0.67.
   3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   5) Cradle to Cradle Material Health Certificate:
      a) Achievement Level: Bronze.
   6) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

o. Fabric: EcoSheer: 6750 series. Cradle to Cradle Certified, woven 100 percent polyester, PVC-free, reversible face, (3 percent open). The first shadecloth to pass NFPA 701 flame tests without added chemical flame retardants.
   1) NRC Rating: 0.15.
   2) SAA Rating: 0.19.
   3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   5) Cradle to Cradle Material Health Certificate:
      a) Achievement Level: Bronze.
   6) Declare label.
   7) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

p. Fabric: EcoSheer: 6850 series. Cradle to Cradle Certified, woven 100 percent polyester, PVC-free, reversible face, (1 percent open). The first shadecloth to pass NFPA 701 flame tests without added chemical flame retardants.
   1) NRC Rating: 0.50.

2) SAA Rating: 0.53.
3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
5) Cradle to Cradle Material Health Certificate:
   a) Achievement Level: Bronze.
6) Declare label.
7) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

q. Fabric: EcoGlass: 2800 series. Cradle-to-Cradle certified, 100% Glass Yarn, 1x1 weave, fully recycleable, 0-1 percent open, PVC-Free, up to 126" wide, passes NFPA 701 flame tests without added chemical flame retardants.
   1) NRC Rating: 0.20.
   2) SAA Rating: 0.22.
   3) Cradle to Cradel Material Health Certifiicate:
      a) Achievement Level: Bronze.

r. Fabric: Acoustiveil: 0890 series. 0-1 percent open. PVC-Free.
   1) NRC Rating: 0.60.
   2) SAA Rating: 0.64.
   3) Cradle to Cradle Material Health Certificate:
      a) Achievement Level: Bronze.
   4) Declare label.
   5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

s. Fabric: EuroTwill: 6000 series. Finely woven. 3 percent open. Reverse side can be used facing interior if specified.
   1) NRC Rating: 0.10.
   2) SAA Rating: 0.14.
   3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

t. Fabric: EuroTwill: 6200 series. Distinctive, tightly woven twill design, comprised of fine polyester with PVC coating. 1 percent open. Reverse side can be used facing interior if specified.
   1) NRC Rating: 0.30.
   2) SAA Rating: 0.33.
   3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment

(LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

u. Fabric: EuroTwill: 6450 series. A broke twill-weave design comprised of fine polyester with PVC coating. 3 percent open. Reverse side can be used facing interior if specified.
   1) NRC Rating: 0.15.
   2) SAA Rating: 0.18.
   3) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   4) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
   5) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

v. Color: Selected from manufacturer's standard colors.

2. Blackout Shadecloths:
   a. Fabric: Equinox Blackout: 0100 series. Opaque. PVC-Free.
      1) NRC Rating: 0.05.
      2) SAA Rating: 0.05.
      3) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.
   b. Fabric: Distinctive Blackout: 0800 series. Opaque.
      1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
      2) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.
   c. Fabric: Chelsea: 0250 series. Opaque. Solid graphite-colored backing. PVC-Free.
      1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
      2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
      3) Cradle to Cradle Material Health Certificate:
         a) Achievement Level: Silver.
      4) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.
   d. Fabric: Chelsea: 0270 series. Opaque. Solid white-colored backing.
      1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
      2) Health Product Declaration (HPD): Published declaration with full disclosure of known hazards.
      3) Cradle to Cradle Material Health Certificate:
         a) Achievement Level: Silver.
      4) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment

(LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

e. Fabric: Classic Blackout: 0700 series. Opaque. Vinyl coated fabric blackout material same color reverse side (for exterior).
   1) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   2) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

f. Fabric: EcoGlass Blackout: 2820 series. Red-List Free, Cradle-to-Cradle certified, 100% Glass Yarn, PVC-Free, fully recyclable, up to 126" wide
   1) Cradle to Cradle Material Health Certificate:
      a) Achievement Level: Bronze
   2) Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
   3) Declare Label: Red List Free
   4) Environmental Product Declaration (EPD): Published disclosure of product's environmental impacts based on a full Life Cycle Assessment (LCA). Manufacturer must have EPD certification by independent 3rd party evaluation service.

g.

h. Color: Selected from manufacturer's standard colors.

3. Performance Requirements:
   a. Flammability per NFPA 701: Pass. Large or small scale test.
   b. Fungal Resistance: No growth when tested per ASTM G21.
   c. Cleanability and Disinfecting: ShadeCloth must meet cleanability and disinfecting requirements via 3rd party testing to comply with BIFMA HCF 8.1-2014 standards using chemical solutions compliant with EPA guidelines for use against COVID-19.
4. Fabrication:
   a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
   b. Battens: Manufacturer's standard material, full width of shade, and enclosed in welded shade fabric pocket; locate as indicated on drawings.
   c. Seams for Railroaded Fabric: Manufacturer's standard seam; locate as indicated on drawings.
   d. Welded Zipper Edge: Full height on both sides of fabric ensuring smooth operation within ShadeLoc channels.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

C. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

B. Turn-Key Single-Source Responsibility for Motorized Interior Roller Shades: Design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified is to be performed by a single manufacturer and their authorized installer/dealer.
   1. The Architect will not provide a set of electrical drawings for installation of control wiring for motors, or motor controllers of motorized roller shades.
   2. General Contractor (GC) To Provide the Following:
      a. Power Panels and Circuits: Size to accommodate roller shade manufacturer's requirements, as indicated on mechanical and electrical drawings.
      b. Coordinate with requirements of roller shade installer/dealer, before inaccessible areas are constructed.
      c. Line voltage as dedicated home runs, of sufficient quantity, and capacity as required. Terminate in junction boxes at locations designated by roller shade installer/dealer.
      d. Run line voltage from terminating points to motor controllers. Wire roller shade motors to motor controllers.
         1) Above-ceiling and concealed wiring to be plenum-rated, or in conduit, as required by the electrical code having jurisdiction.
      e. Use conduit with pull wire in areas, not accessible to roller shade contractor due to building design, equipment location or schedule.
      f. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer’s instructions.
      g. Comply with manufacturer’s current product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
      h. Protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.
      i. Be responsible for all other required electrical work including but not limited to roof penetrations, conduits, fireproofing, etc.
      j. Provide conduit with pull wire in all areas, which might not be accessible to subcontractor due to building design, equipment location or schedule.
   3. Window Covering Subcontractor (WC) responsibilities:
      a. Shade Control Subcontractor shall furnish, install and fully program shade controllers, interfaces, splitters, coupler, sensors, switches, etc. mounted on the wall, in the ceiling, in shade pocket, etc.. Locations for all visible devices to be coordinated with Architect. The shade control subcontractor shall inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.
      b. Run low voltage control wiring from motor controllers to switch/control locations designated by Architect.
         1) Above-ceiling and concealed wiring to be plenum-rated, or in conduit, as required by the electrical code having jurisdiction.

C. Integration with 3RD Party Systems:
   1. Main contractor shall coordinate and provide for others to furnish, install or program any interfaces or wiring to integrate 3rd party systems to the roller shade control system as specified herein. Integration to shade control network can be accomplished locally through IP via UPoE switch with minimum of 60w output per port.

3.4 INSTALLATION

A. Contractor Furnish and Install Responsibilities:
   1. Window Covering Contractor (WC) shall provide an on site, Project Manager, and shall be present for all related jobsite scheduling meetings.
   2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between shade groups, which shall not exceed +/- 0.25” inches (6.35mm).
   3. WC shall be responsible for field inspection on an area-by- area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.
   4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.
   5. WC shall provide accurate to 0.0625” inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
   6. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer’s written instructions, and as specified here in. Blocking for roller shades furnished and installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect’s design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625” (15.875mm) over 20 linear feet (6.096 meters)
   7. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.
   8. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
   9. Installer shall set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
   10. WC shall certify the operation of all motorized shades and turn over each floor for preliminary acceptance.
   11. The WC shall participate and cooperate with the electrical, low voltage and commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.
   12. Clean roller shade surfaces after installation, according to manufacturer’s written instructions.
   13. WC shall train Owner’s maintenance personnel to adjust, operate and maintain roller shade systems.
      a. Use operation and maintenance manual as a reference, supplemented with additional training materials as required.

3.5 PROTECTION AND CLEANING

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.
   1. Clean soiled shades and exposed components as recommended by manufacturer.
   2. Replace shades that cannot be cleaned to "like new" condition.

3.6 MAINTENANCE

A. Provide Owner a proposal as an alternate add to the base bid, a separate renewable maintenance contract for service and maintenance of motorized shade system.
   1. Include a complete description of preventive maintenance, systematic examination, adjustment, parts and labor, cleaning, and testing, with a detailed schedule.
      a. Contract Duration: One year from date of Substantial Completion.
      b. Contract Duration: Two year from date of Substantial Completion.
      c. Contract Duration: _____ from date of Substantial Completion.

END OF SECTION 12 25 13

DIVISION

13

SPECIAL CONSTRUCTION

SECTION 13 09 50 - RADIO FREQUENCY SHIELDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes.

1. Radio Frequency Shielding.
2. Radio Frequency Door(s) and Window(s).
3. Radio Frequency Mechanical Penetration Waveguides.
4. Radio Frequency Electrical Filters.
5. Radio Frequency penetrations required by the magnetic equipment manufacturer.

B. Work coordinated through this Section, but provided by other Sections, shall include the following:

1. Construction work in preparation for shielding installation including foundations, floor, walls, and overhead structures, and door, window, and magnet access apertures.
2. All external connections to shield or shield components by other trades, including those of a structural, electrical, mechanical, or MRI system nature.
3. All internal connections to shield or shield components by other trades, including furring, finishes, electrical, mechanical, and MRI system related items.

C. Work required by this Section, but provided by other Sections, shall include the following:

1. Site access and delivery path for shielding materials.
2. Staging area adjacent to MRI exam room with forklift access.
3. Three electrical convenience outlets.
4. All conventional construction work enveloping and internal to the shielding system, including concrete work, structural and partition walls, ceilings, floors, finishes, etc.
5. All electrical and communications work and materials including inside and outside enclosure connections to electrical filters provided and mounted by the shielding vendor.
6. All mechanical work and materials including inside and outside enclosure connections to duct and pipe penetrations provided and mounted by the shielding vendor.
7. Installation, mounting, or anchoring of MRI equipment vendor's materials or equipment.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Participate in a pre-installation teleconference if requested by the Owner or General Contractor.

B.

1.4 ACTION SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details that disclose methods for attaching or connecting items to the shielding or its penetrations.
4. Clearly indicate what materials and labor is provided by others.

1.5 CLOSEOUT SUBMITTALS

A. Performance Test Report: A copy of all test reports shall be provided to the Owner. Report must show date and time of test, personnel present, specific test methodology, equipment and calibration data, measurements taken and results obtained.

B. Operation and Maintenance data

C. Manufacturer’s Warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Performance testing shall be in strict accordance with MRI equipment vendor requirements. Refer to MRI equipment vendor requirements and documents for specifics. Test enclosure in accordance with IEE-299 modified for MRI system installation.

1.7 PROJECT CONDITIONS

A. MRI exam room and staging area shall be weatherproofed, dry (non-condensing), and temperature controlled between 60^{o} F and 80^{o} F. MRI Exam room shall be free of clutter and debris and the floor broom-swept. Verify conditions before shielding contractor delivers RF shielding components to the site.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of RF Shielding that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year(s) from date of Substantial Completion for: shielding system materials (walls, floor, and ceiling elements) and passive penetrations (waveguides and screened apertures).
2. Warranty Period: 1 year from date of Substantial Completion for doors and active penetrations (electrical filters, switches, etc.).

B.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. PDC Facilities, Inc.
2. 700 Walnut Ridge Drive
3. Hartland, WI 53029-0900
4. (262) 367-7700
5. (262) 367-7744 Fax

2.2 RF SHIELD DESCRIPTION

A. Shield Type: Nickel/Copper polyester non-woven shielding fabric manufactured by Laird Technologies.

B. Walls and Ceiling: Fastening hardware or structural components that contact any element of the shielding system must be made of stainless steel. These shielding elements must be fashioned in such a way that they will accept standard furring and finishes without compromise to RF integrity.

C. Floor: As above. Additionally, the floor must be electrically isolated from the concrete below, preferably with a layer of dielectric epoxy or rigid plastic sheet, not film or paper. Floor underlayment design must be adequate to protect RF shield from damage due to magnet positioning or moisture resulting from normal use and maintenance. Underlayment must accept standard finish flooring methods.

D. Panel systems are not acceptable.

2.3 RF SHIELDING COMPONENTS

A. RF Door:

1. Door shall be manufactured out of aluminum with an unfinished wood veneer insert on both faces. All exposed aluminum shall be polished prior to installation.
2. Door frame shall be manufactured utilizing an aluminum extrusion. The door frame shall be polished before installation.
3. Door frame shall provide integral RF pass thru wave guide for IV tubing if noted in door schedule.
4. Provide factory mortised, fit and hung door dimensioned as indicated in the Drawings.
5. Door must be self-sealing and fit with conventional hospital grade hardware and lockset. Hinges must be ball bearing type and number three (3) per door.
6. Minimum Size: 48 inches wide by 84 inches high.
7. Door Hardware:
    a. Lockset: Sergeant Part Number is SC-11G37 LB 26D. Heavy-Duty Classroom Style Door Lock, L-style Rose and B-Style Lever.
    b. Interlock Switch: Manufacturer’s standard.
    c. Pneumatic Latch Assembly with air delivery system, push plates, and keyed power control.
    d. RF gasketing must be fabric-over-foam type. RF finger stock may not be used. RF sealing shall not be made by use of air. Retractable RF seals are not acceptable.
    e. Threshold must rise no more than 3/8-inch from finish floor.

B. RF Windows:

1. Provide factory-fabricated window unit, ready to mount in shield wall, dimensioned as indicated in Drawings.

2. 3/16 inch tempered safety glass each side of window, with two (2) layers electrically-bonded metal mesh, free of Morie pattern, and coated to eliminate specular reflection and enhance contrast and light transmission.
3. Frame: Plated copper with soldered corners.

C. Ventilation Penetrations:

1. Provide tubular waveguides with integral mounting flange and external dielectric break.
2. Honeycomb type waveguides are only acceptable in areas where tubular types will not fit.
3. Coordinate number and sizes with HVAC consultant.

D. Pipe Penetrations:

1. Provide tubular waveguides with integral mounting flange. Dielectric break provided by others
2. Coordinate number and sizes with mechanical consultant.

E. Electrical and Communication Penetrations:

1. Provide filters for all electrical conductors passing through the RF shield.
2. Power filters are to be UL/CSA rated devices.
3. Coordinate number and sizes with electrical, communications and MRI equipment consultants.

F. Cryogenic Gas Exhaust Vent Wave Guide:

1. Wave guide below cutoff type, size as required by MRI equipment manufacturer.
2. Wave-guide constructed of suitable material to maintain shielding effectiveness equal to that of the shielded enclosure, and to resist failure during a magnet quench event.
3. Provide dielectric connection to the exterior side of the cryogen vent of suitable material to maintain 1000-ohm minimum resistance to earth ground.

G. MRI Equipment Penetrations:

1. Provide mounting aperture and necessary mounting hardware for the MRI equipment filter panel(s) and other equipment-related penetrations as identified by the MRI equipment vendor.
2. Penetrations must meet the minimum attenuation requirements of the RF Shield.

H. Grounding:

1. Provide a ground buss bar per the MRI equipment vendor’s requirements.
2. In the absence of a specific requirement, mount the bar adjacent to the MRI equipment filter panel.
3. Provide 1000-ohm minimum electrical isolation between primary support structure and earth ground.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify on-site conditions affecting the work of this section. Coordinate any discrepancies with Design Architect, General Contractor, and MRI equipment vendor.

B. Start of shielding installation indicates that site conditions are acceptable to shielding contractor.

C. Install materials by, and under supervision, of qualified employees of shielding contractor.

D. Install materials consistent with industry construction standards and in accordance with any special requirements of MRI equipment vendor.

E. At completion of installation, shielding contractor's supervisor shall make final review with General Contractor before leaving the job site of proper procedures and details required by other subcontractors who shall provide work in diagnostic room.

F. If the MRI Magnet is not delivered while the RF contractor is on site, an employee of the shielding contractor must return to open and reseal the magnet access panel when magnet delivery occurs.

3.2 FIELD QUALITY CONTROL

A. During shielding construction, ground isolation shall be monitored at all times using "continuity" indicator.

B. Performance testing will be in strict accordance with MRI equipment vendor requirements and IEE-299. Refer to MRI vendor documentation for specifics. In the absence of MRI vendor requirements, testing will be as follows:

1. Acceptance Test: At the completion of the shield installation, prior to the installation of the MRI equipment vendor's penetrations and magnet, and prior to application of internal walls, ceiling, and finishes, and prior to making any external connections to the shield, the RF contractor will test the enclosure for ground isolation and shielding effectiveness. Ground isolation resistance in ohms will be conducted using calibrated ohmmeter.
2. Ground isolation test must be performed before equipment or power systems are connected.

END OF SECTION 13096

SECTION 13 11 00 - SWIMMING POOLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in the Table of Contents, be included in, and made a part of this Section.

1.2 SUMMARY OF WORK *(for general guidance-not inclusive*)

A. Introduction
   1. Provide labor, materials, equipment, and services necessary to construct the pool(s) and spa. This work must include the structure(s) and installation of pool finishes as well as products listed in Part 2 of Section 13 11 00.

B. Work included in this section:
   1. It is the intent of this section to place the entire responsibility for the construction of the pool(s) (including the construction of the pool shell(s)) under one vested Contractor. Under this section the Contractor will provide but is not necessarily limited to the following:
      a. Provide equipment and services required for erection and delivery onto the premises the equipment or apparatus provided. Remove equipment from premises when no longer required.
      b. Layout, excavate, remove from the construction site, replace, and grade materials as required beyond the limits of excavation of the pool shell(s) to complete the work described in this section. Reference Division 31 - Earthwork.
      c. Grade and replace load bearing or high plasticity index soil, pump and dewater as necessary to keep excavations free from water during construction. Reference Division 31 - Earthwork.
      d. Provide and maintain proper shoring and bracing for existing utilities, sewers and building foundations where required for related excavations. Reference Division 31 - Earthwork.
      e. Provide electrical conduit, wiring, junction boxes etc. to low voltage pool equipment within pool filter/chemical rooms per Division 26 - Electrical. (Low voltage is considered less than 110 V.)
      f. Coordinate for required bonding and grounding of the pool shell, fittings, and equipment.
      g. Provide necessary piping and valving as shown on the drawings and specified herein.
      h. Provide individually sized housekeeping pads for each pool pump. Provide housekeeping pads for pool equipment as required in the drawings.
      i. Provide the main drain hydrostatic relief system and a sight sump as shown on the drawings. Reference Division 31 - Earthwork.
      j. Construct the cast in place or pneumatically applied concrete pool shell(s) and cast in place surge tank(s) as described in these specifications and detailed on the drawings, including reinforcement steel, inserts, fittings, fiberglass main drain sumps and embedded items (piping, anchors, etc.) for the pool(s) and spa.

Reference Division 3 - Concrete and Structural. Before commencing the placement of concrete, verify electrical bonding of the pool and spa embedded items and reinforcing steel. Also, coordinate and arrange required electrical, plumbing and or building inspections.

k. Provide a proprietary aggregate cementitious finish finish in the pool(s) with a slip resistant surface with a vertical tile band. Provide specialty tile for the perimeter tile deck band, gutter nosing, wall targets, recessed steps, toe ledge, floor lane markings, depth markings and warning, construction joint installation bands and other tile installation within the pool structures. Provide a fully tiled finish in the Spa. Reference Section 13 11 03 - Swimming Pool Tile - including the tolerance requirements for the concrete substrate.

l. Provide fully assembled cleaning and maintenance equipment for the pool(s) as specified herein.

m. Provide for the storage of pool related equipment, materials, and systems. Items are the responsibility of the Contractor until accepted by the owner.

n. Obtain final acceptance by jurisdictional health department(s).

o. Start, test, calibrate and adjust mechanical equipment, electrical equipment, recirculation, chemical, and other supplied systems including deck, loose, maintenance, and safety equipment. Instruct the Owner's representative in the systems operation and maintenance as described herein.

p. Provide the heating system for the pool(s) and spa. Include piping, heaters, heat exchangers, booster pumps, controls, gauges, thermostats, control valves and wiring required to draw water from the recirculation line, heat the water and return it back to the recirculation line and interlock with pool recirculation pumps.

C. Related work specified in other sections:

1. Section 13 11 04 – Swimming Pool Cementitious Finish
2. Section 13 11 03 – Swimming Pool Tile
3. Section 13 11 06 – Swimming Pool Timing System
4. The following work related to the swimming pools must be completed by other trades.
   a. Provide, erect, and maintain necessary barricades, signs, lights, and flares for pool construction to protect workers and the public.
   b. Provide and maintain proper shoring and bracing for existing utilities, sewers and building foundations where required for swimming pool related excavations. Reference Division 31 - Earthwork.
   c. Provide sub-surface drainage beneath the pump pit and backwash pit where may be required by Geotechnical Report. Reference Division 31 - Earthwork.
   d. Construct pump pit and backwash pit including reinforcement, inserts, wall sleeves, anchors, access hatches, and fittings. Reference Division 3 - Concrete.
   e. Layout, excavate, remove from the construction site, replace, and grade materials as required beyond the limits of excavation of the pool shell(s) to complete the work described in this section. Reference Division 31 - Earthwork.
   f. Prior to concrete pours, verify electrical bonding of the pool embedded items. Coordinate and arrange required electrical, plumbing and or building inspections that must be performed on embedded items. Reference Division 26 - Electrical.
   g. Provide sanitary sewer and storm drain connections. Reference Division 22 - Plumbing.
   h. Provide deck finish beyond perimeter tile band. Reference Division 9 - Finishes.
   i. Provide rules and regulations signage as required by code. Reference Division 1 - General Requirements.
   j. Provide chlorine resistant caulking (sealant) and backer rod on pool decks. Reference Division 7 - Thermal and Moisture Protection.

D. Related work specified in Plumbing section. Reference Division 22 - Plumbing. Work that must be completed by others.
   1. Provide trench drains and/or area drains on pool deck.
   2. Provide sanitary sewer piping in the pool mechanical room including floor drains, sumps, and sump pump.
   3. Provide water service to hose bibbs, flush hydrant boxes and auto-fill bypass to air gap above fill funnel(s). Install the slow closing solenoid valve(s) in the bypass auto-fill piping.
   4. Provide water meter on the fresh water supply line upstream of the manual fill valve and the install the slow closing solenoid valve.

E. Related work specified in Mechanical section. Reference Division 23 –HVAC. Work that must be completed by others.
   1. Provide related systems for supplemental pool water heating.
   2. Provide air recirculation systems for pool related spaces.

F. Related work specified in Electrical sections. Reference Division 26 – Electrical. Work that must be completed by others.
   1. Provide power to the exhaust fans for the chemical rooms.
   2. Provide motor starters, auxiliary contacts, magnetic relays, emergency stops and other electrical control devices necessary for the complete operation of the pool systems. Provide power to Variable Frequency Drive pool pump starters and power from VFD to the pool pump motor.
   3. Ground and bond pool structures, fittings, and equipment in accordance with Article 680 of the N.E.C. Test and verify that the system electrical ground is true and solid. Provide certification to this effort.
   4. Obtain permits, inspections, and approvals of wiring including grounding and bonding of metal components associated with the pool in accordance with Local, State and National Electrical Codes.
   5. Provide power, conduits, electrical boxes, and wiring for the Contractor provided electronic timing and scoreboard system with multi-sport capability for race swimming and pace clock.
   6. Provide power, conduits, electrical boxes, and wiring for the underwater lights and junction boxes.
   7. Confirm electrical conduits that penetrate the pool shell are watertight and installed per N.E.C. Article 680.

1.3 QUALITY ASSURANCE

A. The specifications and drawings illustrate and detail three (3) swimming pool systems that are utilized for both competitive and recreational use. Certain technical aspects of the design are common only to pool systems planned for public use. Understanding these aspects, their functions and interaction through experience is vital to completing a successful operating system. It is a mandatory requirement that the Contractor have achieved such experience as a prerequisite for bidding on this project.
   1. The Swimming Pool Contractor to refer to section 00 21 13 – Instructions to Bidders for bonding requirements.
   2. The Swimming Pool Contractor must include a bid bond from an approved surety company registered in the State of Louisiana certifying that the Swimming Pool Contractor has adequate bonding capacity to provide a bid for this project. The Swimming Pool Contractor must submit a copy of the bid bond for review prior to the Swimming Pool Contractor’s selection.

3. If the Contractor has not received prior written approval for this project or has not been included in the pre-approved list of Contractors, they must submit a list of projects meeting the aforementioned qualifications, including contact information of the General Contractor must be submitted for review and approval at least 10 days prior to bidding of the project. The Contractor must have completed at least five (5) public-use pools with individual water surface areas in excess of 4500 square feet and a depth of 11'-6" or more within the past 10 years.
4. The Contractor must submit prior to the start of construction the name of the on-site Project Superintendent including their relevant experience. The Contractor's on-site Project Superintendent must have completed at least five (5) public-use pools with individual water surface areas in excess of 4500 square feet and a depth of 11'-6" or more within the past 10 years. A list of projects meeting the aforementioned qualifications, including contact information of the General Contractor as well as Owner must be included with the experience submittal. Project Superintendent on the project cannot change unless written authorization has been provided by the Architect and Owner.
5. The Owner reserves the right to reject a bid if the evidence submitted by, or investigation of, the Contractor fails to satisfy the Owner that the Contractor is properly qualified to carry out the obligation of the contract and to complete the work described or if the Contractor does not have the qualifications stated herein. Subject to compliance with item 2 above on this specification.
6. The following Contractors have been pre-approved. The Contractor must meet the requirements listed above.

Acapulco Pools/Gall Construction Bernie Gall, John Robb 11811 North Tatum Boulevard Suite 3031 Phoenix, Arizona 85028 p: 602.354.1181 e: bernie@acapulcopools.com	Sunbelt Pools Rob Morgan, Phil Collins 10555 Plano Rd Dallas, Texas 75238 p: 214.343.1133 e: philc@sunbeltpools.com
Allison Aquatic Group Sonny Arnold P.O. Box 905, Denison, TX 75021 112 Seymore Bradley Rd Denison, TX 75020 p: 903.465.6073 e: sonny@allisonpools.com	Rotolo Consultants Inc. (RCI) Michael Rotolo 38001 Brownsvillage Rd Slidell, Louisiana 70460 p: 985.643.2427 e: mrotolo@rotoloconsultants.com
Atlantis Aquatic Group Ronnie Carlson, Dennis Watson 7700 Hwy 71 West Austin, Texas 78735 p: 512.243.6877 e: dennis@atlantisaquaticgroup.com	Landmark Aquatics Kelley Humble 2510 Farrell Road Houston, Texas 77073 p: 281.404.0445 e: kelley@proaquatic.com

1.4 REGULATORY AGENCY REQUIREMENTS AND ENGINEERING SERVICES

A. The system must comply with necessary pre-construction approvals.

B. Give necessary notices, obtain permits, and pay government fees, and other costs in connection with his work, including the filing of necessary as-built drawings, prepare

documents (including any amendments to the approved construction documents) and obtain necessary approvals of governmental departments having jurisdiction over their work. Obtain required certificates of inspection for his work and deliver copies to the Owner and Architect before requesting acceptance and final payment for the work.

C. Include in the work, without extra cost to the Owner, labor, materials, services, apparatus, or drawings in order to comply with applicable laws, ordinances, rules, and regulations, whether or not shown on drawings and/or specified.

1.5 COORDINATION AND CLARIFICATION

A. Coordinate with other trades' work relating to this section.

B. Must establish with other trades, having related work in this section, that work necessary to complete the pool(s) as shown on the drawings and in the specifications is included in the base bid and alternates to the Owner.

C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.6 ALTERNATES

A. Review the description of the alternates in Division 1 and on the drawings for possible effect upon work in this section. Alternates related to the work in this section are described in this division and on the bid proposal form.

B. Pool Alternates
1. N/A

1.7 CONTRACTOR'S ALTERNATE PROPOSAL

A. Submit bid to the owner based on materials, equipment and methods as specified in this Section. No substitution of material will be allowed.

B. It is the intent of the contract documents to encourage competition. The base proposal must include the construction methods and equipment as specified and detailed. Proposed system substitutions must have prior written approval by the Architect.

C. If there is a deviation from the basis of design equipment, confirm that engineering criteria are appropriate for the substituted equipment.

D. Substitutions of specified construction methods and equipment must include a complete submittal as required by these specifications and drawings of appropriate scale incorporating required changes. Provide a list of at least ten (10) satisfactory installations comparable to this project that have been manufactured and installed under the manufacturer's current legal name. Submit a list of such projects with the name, address and current telephone number of the Owner's Operator and Architect of Record to the Architect on the bid date.

E. Changes or modifications to the Contract Documents that are not authorized by the architect are the sole responsibility of the Contractor.

1.8 SUBMITTALS

A. Submittals must be made in accordance with the requirements of Division 1 - General Requirements and in strict compliance with the following procedures and guidelines.

B. One (1) set of shop drawings and engineering data must be tabbed, indexed, and referenced to the specifications, compiled into an electronic submittal, and submitted in two stages. The first stage must include items for the pool shell(s), reference swimming pool structural specifications. The second stage must be for remaining items. Each section of items must be prefaced by a cover sheet listing the items submitted within the section. Electronic submittals must be organized, numbered, and submitted in the same format and order as the project specifications. Only complete sets will be reviewed.
   1. Engineering data covering systems, equipment, structures, and fabricated materials, which will become a permanent part of the work under this contract, must be submitted for review. This data must include drawings and descriptive information in sufficient detail and scale to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorage and supports required; performance characteristics; fabrication and dimensions needed for installation and correlation with other materials and equipment. A certification, in writing, must be provided indicating that equipment will fit in the space allotted and as shown on the drawings.
   2. Submittals regardless of origin must be stamped with the approval of the Contractor and identified with the name and number of this contract, Contractor's name, and references to applicable specification paragraphs and contract drawings. Each submittal must indicate the intended use of the item in the work. When catalog pages are submitted, applicable items must be clearly identified. The current revision, issue number, and date must be indicated on drawings and other descriptive data.
   3. The submittals will not be accepted from anyone but the Contractor. Submittals must be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.
   4. The Contractor's stamp of approval is a representation that the Contractor accepts full responsibility for determining and verifying quantities, dimensions, field construction criteria, materials, catalog numbers and similar data, and that he has reviewed or coordinated each submittal with the requirements of the work and the contract documents.
   5. Each submittal must include a statement prepared by the originator of the drawings and data, certifying compliance with the contract documents except for deviations, which are specifically identified.
   6. Deviations from the contract documents must be identified on each submittal and must be tabulated in the Contractor's letter of transmittal. Such submittals must, as pertinent to the deviation, indicate essential details of changes by the Contractor (including modifications to other facilities that may be a result of the deviation) and required piping and wiring diagrams.
   7. The Contractor must accept full responsibility for the completeness of each submission, and, in the case of a resubmission, must verify that exceptions previously noted have been considered.
   8. The need for more than one resubmission, or a delay in obtaining review of submittals, will not entitle the Contractor to an extension of the contract time unless the delay of the work is directly caused by a change in the work authorized by a change order.
   9. Review of drawings and data submitted by Contractor will cover only general conformity to the drawings and specifications, external connections and dimensions that affect the layout. Review does not indicate a thorough review of dimensions, quantities, and details of the material, equipment, device, or item shown. Review of

submittals does not relieve Contractor from responsibility for errors, omissions, or deviations, or responsibility for compliance with the contract documents.

10. When the drawings and data are returned marked REJECTED, REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM, the corrections must be made as noted thereon and as instructed and six corrected copies (or one copy and one corrected reproducible copy) resubmitted.
11. Resubmittals must bear the number of the first submittal followed by a letter (A, B, etc.) to indicate the sequence of the resubmittal. Resubmittals must be indexed, tabbed, referenced to the specifications, and bound in a three-ring binder and submitted at one time.
12. When corrected copies are resubmitted, the Contractor must, in writing, direct specific attention to revisions and must list separately revisions made other than those called for on previous submissions.
13. When the drawings and data are returned marked NO EXCEPTIONS TAKEN or MAKE CORRECTIONS NOTED, no additional copies are to be provided unless specifically requested to do so for record.

C. Permits, Receipts and Test Reports
   1. Provide the Architect with copies of permits and receipts for fee payments.
   2. Submit a sample format for each test report intended for use. Submit test reports required herein only on approved forms.

D. Include complete product data indexed, tabbed, and referenced to specifications with 8 ½" x 11" cover sheet covering:
   1. Paragraph 2.01 - Overflow System
   2. Paragraph 2.02 - Pumping Equipment
   3. Paragraph 2.03 - Filtration Equipment
   4. Paragraph 2.04 - Recirculation Fittings
   5. Paragraph 2.05 - Piping Systems
   6. Paragraph 2.06 - Chemical Treatment Systems
   7. Paragraph 2.07 - Chemistry Monitoring and Control Systems
   8. Paragraph 2.08 - Flow Meters
   9. Paragraph 2.09 - Water Level Controllers
   10. Paragraph 2.10 - Deck Equipment
   11. Paragraph 2.11 - Loose Equipment
   12. Paragraph 2.12 - Maintenance Equipment
   13. Paragraph 2.13 - Safety Equipment
   14. Paragraph 2.14 - Thermometers
   15. Paragraph 2.15 - Swimming Pool Finishes
   16. Paragraph 2.16 - Waterproofing
   17. Paragraph 2.17 - Sealants
   18. Paragraph 2.18 - Underwater Lights
   19. Paragraph 2.19 - Water Features and Support Equipment
   20. Paragraph 2.20 - Pool Heaters

E. Include engineering/construction drawings for the pool structure.
   1. Reference Division 3 - Concrete.

F. Include engineering construction drawings for pool piping.

G. Include separate submittal for all color selections required to be made by the Owner/Architect. Physical samples and/or mock ups must be provided as requested and submitted for review. The following items must be included:

1. Gutter Grating
2. Sight Sump Frame and Cover
3. Starting Blocks
4. Pool Lift
5. Competition Floating Lane Ropes
6. Backstroke Flags
7. Swimming Pool Cementitious Finish – Reference Section 13 11 04
8. Swimming Pool Tile - Reference Section 13 11 03
9. Sealants

H. Reference Section 13 11 04 - Swimming Pool Cementitious Finish

I. Reference Section 13 11 03 - Swimming Pool Tile

J. Reference Section 13 11 06 - Swimming Pool Timing System

1.9 TESTING REPORTS

A. Provide all testing reports as described in the specifications. Testing report(s) and any additional documentation of the test(s) must be submitted to the Architect within seven (7) days of the commencement of the test(s) unless otherwise noted. The following testing report(s) must be submitted for review/record:
   1. The pool piping must be capped and hydrostatically pressure tested prior to backfilling. Hydrostatic pressure tests must be performed by the Contractor and witnessed by the Owner, or a representative designated by the Owner.
   2. The pool(s), gutter(s), surge tanks(s), and spa must be tested for water tightness prior to the application of any finishes. The water tightness test must be performed by the Contractor and witnessed by the Owner, or a representative designated by the Owner.
   3. The domestic water must be analyzed prior to filling the pool(s) after the application of the plaster finish. The Contractor must provide a domestic water analysis by a water testing agency to determine types and quantities of chemicals required to ensure calcium-balanced water immediately upon the completion of filling the pool(s). Refer to specification 13 11 04.
   4. The slump of the plaster finish must be tested should a plastering machine be used. The Contractor to perform slump test to ensure slump does not exceed 2.5” when tested using a 2" by 4" by 6" high slump cone. Refer to specification 13 11 04.
   5. The spa tile finish must be visually inspected and sound tested prior to filling the pool. The visual inspection and sound testing of the tile finish must be performed by the Contractor and witnessed by the Owner, or a representative designated by the Owner. Refer to specification 13 11 03.
   6. Concrete test panels/cylinders must be tested for compressive strength. The Contractor to produce test panels/cylinders to be tested by a third-party testing agency provided by the Owner. Refer to Division 3 – Concrete

1.10 OPERATION AND MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS

A. Detailed operation and maintenance information must be supplied for equipment requiring maintenance or other attention. The equipment supplier and/or the Contractor must prepare an operation and maintenance manual for equipment. Parts lists and operating, and maintenance instructions must be provided.

B. Each operation and maintenance manual must include the following:

1. Equipment function and calibration, normal operating characteristics, and limiting conditions.
2. Assembly, installation, alignment, adjustment and checking instructions.
3. Operating instructions for startup, routine and normal operation, regulation, and control, shut down and emergency conditions.
4. One (1) copy of instructional videos.
5. One (1) copy of Safety Data Sheet forms for all pool chemicals provided.
6. Operating cycles must be specifically described in outline format and in referenced detail. A wall-mounted color-coded piping flow diagram must be provided in the pool equipment room. The diagram must be engraved on laminated plastic with color-coded piping to match the color of coding on piping, and including valves identified with number on tags. The minimum size is 11-inch x 17 inch.
7. Include manufacturer recommended maintenance schedule, parts lists, piping diagram (to agree with wall mounted diagram) and trouble-shooting information for pool mechanical equipment.
8. Using reference to keyed valves and wall diagram, include specific written instructions for procedures that must be followed for the following:
   a. Emptying and refilling the pool(s) including de-watering during the period that the pool(s) will be empty.
   b. Water level control adjustment and chemical control operation.
   c. Normal surge tank operation and balancing.
   d. Filter operation and backwashing; and
   e. Super chlorination.
9. Lubrication and maintenance instructions.
10. Guide to “troubleshooting.”
11. Parts list and predicted life of parts subject to wear.
12. Outline, cross section, and assembly drawings; engineering data and wiring diagrams.
13. Test data and performance curves, where applicable.
14. Specific written instructions for procedure for emptying and refilling the pool(s) including de-watering during the period that the pool will be empty. Provide a yellow warning sign 8-1/2 in. x 11 in., that must be mounted in the pool mechanical room, that reads:

    WARNING
    Prior to emptying Pool
    Consult O & M Manuals for Procedures

    Add another sign that reads:

    Keep Caps, Plugs and Tops Tight Fitting to Prevent Escape of Fumes.
15. Additionally, provide the following signs mounted on the chemical room doors:
    a. NFPA Hazard Diamond for each chemical stored in room.
    b. Warning: Authorized Personnel Only Beyond This Point
    c. Signage indicating location of associated Safety Data Sheet forms for all chemicals stored in room.
16. One set of applicable submittals must be included in each manual.

C. The operation and maintenance manuals must be in addition to instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by the Contractor.

D. Manuals and other data must be printed on heavy, first quality paper, 8-1/2 x 11-inch size with standard 3-hole punching and inserted in plastic covers. Drawings and diagrams must

be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practical, larger drawings must be folded separately and placed in envelopes that are bound into the manuals. Each envelope must bear suitable identification on the outside.

E. Six (6) bound volumes of each manual must be submitted. Parts lists and information must be assembled in substantial manuals and permanent, three-ring or three-post binders. Material must be assembled and bound in the same order as specified, and each volume must have a table of contents and suitable index tabs.

F. Material must be marked with project identification. Non-applicable information must be marked out or deleted.

G. Shipment of equipment will not be considered complete until the required manuals and data have been received.

H. The Contractor must provide, assemble, and inventory all deck, loose, safety, and maintenance equipment including any loose mechanical equipment prior to the Owner taking possession of the pool(s). The Contractor must provide a checklist that has been signed by the Owner verifying receipt of all items listed in Part 2 - Products.

1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original, unopened containers and crates with labels intact and legible.

B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.

C. Handle materials in a manner to prevent damage.

D. Store materials on clean raised platforms with weather protective coverings. Provide continuous protection of materials against damage or deterioration.

E. Remove damaged materials from site.

1.12 WARRANTIES

A. The Contractor warrants to the Owner and Architect that materials and equipment provided under the contract will be of good quality and new unless otherwise required or permitted by the contract documents, that the work will be free from defects not inherent in the quality required or permitted, and that the work will conform with the requirements of the contract documents. Work not conforming to these requirements, including substitutions not properly approved and authorized will be considered defective. The Contractor’s warranty will exclude remedies for damage or defect caused by abuse, improper or insufficient maintenance, improper operations, modifications not executed by the Contractor or improper wear and tear under normal use. If required by the Architect, provide satisfactory evidence as to the kind and quality of materials and equipment.

B. The Contractor must agree to repair or replace defective or non-complying work at no cost to the Owner upon written notification from the Owner within the warranty period. Pro-rated warranties are not acceptable.

C. Warranties must be for a period of one year from the date of substantial completion or the owner begins using the pool unless otherwise specified. Submit warranties covering, but not limited to the following:

1. Defects in material or workmanship of the pool and surge tank structure(s) causing a loss of water for a period of three (3) years.
2. Defects in material, manufacture and installation of the filtration, backwash, chlorination, pH adjustments and cleaning systems, including controls for a period of one (1) year.
3. Defects in material, manufacture or installation of the recirculating overflow system and interior coating of the gutters for a period of one (1) year.
4. Manufacturer's minimum ten (10) year warranty against defective materials, components, and workmanship in the pool gutter grating system.
5. Defects in material, workmanship, and installation of the pool pumps for a period of one (1) year.
6. Manufacturer's minimum eighteen (18) month warranty against defective materials, components, and workmanship in the variable frequency drive system.
7. Manufacturer's minimum fifteen (15) year warranty on the filter tank against defective materials or workmanship of the tank and components. (Additional warranty time may be purchased from the manufacturer.) Prorated warranties are not acceptable.
8. Defects in material, workmanship, and installation of the pool piping system and recirculation fittings for a period of three (3) years.
9. Manufacturer's minimum one (1) year warranty against defective materials, components, and workmanship in the sanitizing feed system.
10. Manufacturer's minimum one (1) year warranty against defective materials, components, and workmanship in the pH buffer feed system.
11. Manufacturer's minimum one (1) year warranty against defective materials, components, and workmanship in the ultraviolet sanitizing system (excluding the UV lamps, quartz, and seals). Medium pressure ultraviolet bulbs must be warranted for a period of 8,000 hours. Intermittently operated lamps (≥ 1 on/off cycle per day) will be replaced free of charge should failure occur prior to 4,000 hours and replacement will be prorated between 4,000 and 8,000 hours.
12. Manufacturer’s minimum three (3) year warranty against defective materials, components, and workmanship in the Clear-Flow Electronic Flocculation System (EFS).
13. Manufacturer's minimum five (5) year warranty against defective materials, components, and workmanship in the pool chemical controller. ORP, pH, flow and temperature sensors must be covered by a standard two (2) year warranty. Other sensors and flow cell components must be covered by a standard one (1) year warranty.
14. Manufacturer's minimum one (1) year warranty against defective materials, components, and workmanship in the pool water level control system.
15. Defects in material, workmanship, and installation of loose, deck, maintenance, and safety equipment including deck anchors for a minimum period of one (1) year.
16. Defects in material, workmanship, and installation of the pool cementitious finish against cracking and delamination for a period of three (3) years.
17. Defects in material, workmanship, and installation of the tile finish against cracking and delamination for a period of five (5) years.
18. Manufacturer's minimum fifteen (15) year systems warranty against defective materials, components and workmanship in the pool tile setting materials.
19. Defects in material, workmanship and installation of the surge tank, gutter, and backwash pit waterproofing finish against delamination for a period of one (1) year.
20. Manufacturer’s minimum two (2) year warranty against defective materials, components, and workmanship in the pool underwater lights.
21. Manufacturer's minimum five (5) year warranty on the complete heat exchanger assembly for the Lap Pool and Wellness Pool heaters. Manufacturer's minimum three (3) year warranty on the complete heat exchanger assembly for the Spa heater.

1.13 SYSTEM TRAINING

A. A qualified representative of the Contractor performing work under this section must put the equipment into operation and instruct the Owner's representatives in the operation of this equipment to the Owner's satisfaction immediately after project's substantial completion.

B. The Contractor's training representative must have completed the equipment/system's manufacturer's training requirements and be certified, by the manufacturer, to provide and teach system training.

C. The representative from the Contractor must be either a CPO (Certified Pool Operator) or have an AFO (Aquatic Facility Operator) certification.

D. Training periods to consist of 32 hours of on-site training and scheduled as follows:
   1. 16 hours of initial training on the complete swimming pool system. The 16 hours of initial training must be comprised of at least 4 hours of training on water chemistry analysis and adjustment. The water chemistry training will include in-depth review of the use of the Langlier index and its computation.
   2. The initial 16 hours of training must include information on the care, operation, adjustment, and maintenance of items provided by the Contractor under the "Part 2 – Products" section of this specification.
   3. 16 hours of training after the Owner's staff has had experience operating the system. This time may be requested after the pool has been placed in operation within a period of one (1) year from the time the pool was accepted by the Owner. The additional training must contain at least 2 hours of review of water chemistry.
   4. Provide a project specific video recording instruction manual in addition to the training sessions. The video instructions must be project specific and must include information on the care, operation, adjustment, and maintenance of items provided by the Contractor under the "Part 2 – Products" section of this specification. This video recording must be done separate from the Owner training.
   5. The Contractor must include one (1) copy of video recording instructions in each Operations and Maintenance Manual.

1.14 POOL FILL WATER QUALITY

A. The Owner is to bear the cost of the water required for one (1) complete filling of the pools and spa (the final filling). Removal of iron or copper (if in excess of .3 ppm) will be required for the final fill to avoid staining of the pool finish. Subsequent fillings or partial fillings (more than 25%) of the pool is by the Contractor, at its own expense.

B. Provide the necessary plant equipment so that the temperature of fill water will be within plus or minus 10 degrees of the ambient air and/or the pool structure at the time of filling. Extreme caution is urged if the temperature variance is greater than 10-degree F.

C. Provide the necessary chemicals and to adjust and balance the water chemistry in the pools to the following levels:

pH	7.4 - 7.6
Calcium Hardness	200 - 400 PPM
Total Alkalinity (Calcium Hypochlorite)	60 - 80 PPM
Langelier saturation index	-0.3 - +0.3
Total Dissolved Solids (TDS)	not to exceed 1,500 PPM

1.15 START-UP CHEMICALS

A. The Contractor must maintain the chemical balance of the pool water (including the cost of chemicals required) until the pool and mechanical system(s) are fully operational and accepted by the Architect and the Owner.

B. Provide the Owner with sufficient quantities of the necessary chemicals to maintain the pool operation after the owner begins using the pool.
   1. The Contractor is required to provide chemical quantities as shown on the drawings for the following chemicals:
      a. Calcium Hypochlorite
      b. Muriatic Acid
   2. The Contractor is required to provide chemical quantities as shown on the drawings for the following balancing chemicals:
      a. Sodium Bicarbonate
      b. Calcium Carbonate
      c. Sodium Thiosulfate

C. Chemicals must be provided to the Owner must include those required by the chemical feed systems provided.

1.16 RECORD DRAWINGS

A. Provide a complete set of record drawings of the entire pool system(s) including sub-systems. Record drawings must be prepared in accordance with the requirements of Section 01 78 39 and must be a complete, stand-alone set. The Contractor is permitted to obtain original documents and copy them for this purpose only. Provide a digital record set (latest version of AutoCAD or compatible software).

PART 2 PART 2 - PRODUCTS

2.1 OVERFLOW SYSTEM

A. It is the intent of the specifications that the perimeter overflow system and surface cleaning be maintained under conditions of normal operation and that no water be discharged to waste except when cleaning the filters or emptying the pool.

B. Concrete Perimeter Overflow System
   1. A perimeter overflow system consisting of a continuous concrete and tile overflow channel must be provided as detailed and shown on the drawings for the pool(s). The bottom of the trough must be level throughout.
   2. The complete gutter trough interior must be coated with epoxy paint.
   3. Grating corner installations must be prefabricated thermo-welded corner sections provided by the grating manufacturer and installed with adequate support per manufacturer recommendations. Butting grating sections together at corners is not permitted.
   4. The grating must be formed of molded PVC sections. Modular, interlocking pieces of UV stabilized PVC grating. The top surface must have a raised, diamond ridge design to create good friction, wet or dry and be 11/16” wide with an outside depth of 1.0” and a middle depth of 1-3/8” for extra strength. The space between pieces must not exceed 3/8”. Each piece of grate must have a slotted hole at the ends for insertion of a stainless-steel fastener clip and anchor screws every 5 feet and must be easily removable. Grating surface bars must run parallel to the pool wall and with the gap, provide at least 35% open space per foot for unrestricted water flow. The color of the grate must be selected

by the Owner/Architect. The width of the grating must allow the insertion of the touchpad holding brackets between the grating and the gutter lip.

a. Basis of Design: Grating must be manufactured by Daldorado, Lawson Aquatics supplied by Neptune-Benson, or approved equal.

5. Materials, anchors, and fasteners must be 316L stainless-steel.

C. Skimmer Overflow System

1. Provide skimming system consisting of units as shown on the drawings. Skimmers must be located to ensure maximum skimming action.
   a. Basis of Design: Spa skimmers must be Admiral SC-20 by Pentair Products or approved equal.
2. The piping and other pertinent components of skimming equipment must be designed for a total capacity of the required filter flow of the recirculation system, and no skimmer can be designed for a flow-through rate of less than 30 gallons per minute or 5 gallons per minute per lineal inch of weir.
3. The skimmer weirs must be automatically adjustable and must operate freely with continuous action to variations in water level over a range of at least 4 inches. The weirs must operate at flow variations. The weir must be of such buoyancy and design so as to develop an effective velocity.
4. An easily removable and cleanable basket or screen through which overflow water passes must be provided to trap large solids.
5. The skimmer equalizer fitting at the base must be capped.
6. The skimmer must be of sturdy, corrosion-resistant materials.
7. Each skimmer must be equipped with a variable orifice trimming device to allow balancing of flow.
8. Skimmers must be NSF approved.
9. Provide a solid aluminum or fiberglass lintel plate spanning the top of each skimmer throat opening in the pool wall to support the pool coping. Lintel to have dimensions of 7-3/4” by 2’-0” and be 3/8” thick. Aluminum lintel plates require bonding in accordance with NEC Article 680. Fiberglass lintel plates must be of rigid design with factory finished or field sealed edges to prevent exposed jagged surfaces and moisture intrusion into the fiberglass material.

2.2 PUMPING EQUIPMENT

A. Proposed substitutions must include a mechanical drawing incorporating required changes in layout, piping, and valves. The cost of such changes must be included in the price of the substitute. Confirm correct pump motor voltage prior to ordering pump. Motors must be capable of continuously running without overloading at points on the characteristic curve of the pump without overload or damage. Confirm by 1/4-inch scale shop drawing that the pumps provided will fit within the available space and can be reasonably removed for servicing.

1. Pumps must be certified by the National Sanitation Foundation (NSF) and bear the certification mark.
2. If the pump is powered with a VFD, the impeller must be trimmed to a maximum diameter based on the most limiting condition of either the diameter of the maximum non-overloading rated motor horsepower at the design point or a diameter resulting in 10% greater head than the specified head.
3. The pump motor must be totally enclosed, fan cooled (TEFC) and premium efficiency of the horsepower and speed specified. A pump requiring larger horsepower is not acceptable unless submitted as a substitute and approved by the engineer, in which case necessary electrical revisions must be coordinated and provided.

4. Provide an emergency shutoff switch for the pool(s) and spa pump(s). One (1) switch must be provided for each complete pool and spa system, including all recirculation and feature pump(s). The system must include a clearly labeled emergency shutoff switch for pool and spa pump(s) per Article 680-38 of the NEC. Emergency switch must include tamper-resistant/weather-resistant cover and audible alarm. Architect to approve the location of the switch(es) no less than 5'-0" from the pool or spa wall and within sight of pool or spa users. The wiring must be done per Division 26 and coordinated with the pool wiring.
    a. Basis of Design: STI SS2202PO-EN with cover or approved equal.
5. Provide a 15-minute spa timer for each hydrotherapy pump. Architect to approve the location of the timer(s). The wiring must be done per Division 26 and coordinated with the pool wiring. Basis of design: Intermatic DPST #FD415M or equal.
6. The entire pumping unit must be mounted on a base using cap screws to preserve the back-pull-out feature of the pump. Pumps must not be secured with floor studs or "all-thread." The pump base must be coated with the same epoxy coating as the pump. An OSHA approved guard must protect coupling and exposed rotating components of the pump and motor where required.
7. Recirculation and Feature Pumps – Metallic Components
    a. Provide horizontally mounted centrifugal pumps as shown on the drawings and described in these specifications. Each pump must be of a straight centrifugal, end suction, bronze fitted, close coupled type.
    b. Pumps manufactured by Paco, Griswold, Aurora, or Herborner are considered equal, provided they meet the requirements.
    c. Pump casing must be cast iron fitted with a replaceable bronze case wear ring. Mechanical seals must be provided specific for a chlorinated water application. Pump impeller must be enclosed type of cast bronze or 316L stainless-steel, statically, and dynamically balanced, and trimmed for the specified design conditions. If a VFD is used in conjunction with a pump, the impeller must be trimmed to the maximum diameter based on the rated motor horsepower. Bronze materials must be suitable for use in a chlorinated environment. Suction and discharge flanges must be provided and tapped for gauge connections. Provide steel or cast-iron bases with equivalent epoxy coating for corrosion protection.
    d. Provide a fusion-bonded epoxy coating on wetted parts to protect pump internals from corrosion, including pump volute interior and complete pump impeller (bronze impellers only). Sandblast to bare, white metal. The thickness must be 8 to 12 mils (heavy film). Verify thickness by non-destructive testing. Coat parts as recommended by the manufacturer, including preheating parts to 400 degrees and electrostatic deposition or fluidized bed technique. Provide primers if required to resist chlorinated water <10 ppm. The coating must be Scotchkote 134 manufactured by Fusecote or approved equal.
    e. Provide a hair and lint strainer, for each pump, of fiberglass or epoxy coated stainless-steel construction with a clear observation top in the sizes (or pipe sizes) indicated on the drawings. Provide hair and lint strainers with perforations no greater than 1/16" for feature pumps as indicated on the drawings. Verify and coordinate pipe and pump suction sizes in the field. Strainer must be of a low pressure drop full-open or a tapered eccentric reducing type. Straight reducing type strainers will not be acceptable without the addition of an approved tapered eccentric reducer between the strainer and the pump (in which case, sufficient space in the pump pit must be verified). Provide a stainless-steel basket with at least four (4) times the free open area as the inlet pipe, and one spare basket with each strainer.

1) Basis of Design: As manufactured by MerMade Filter Inc., or Neptune/Benson Inc., or Fluidtrol Process Technologies, Inc.

f. Recirculation pumps must be provided by the same manufacturer. Confirm voltages prior to ordering pumps.

8. Recirculation and Feature Pumps – Composite Components
   a. Provide horizontally mounted, self-priming, centrifugal pumps as shown on the drawings and described in these specifications. The pumps must be of a straight centrifugal, end suction, non-corrosive PPO Resin material construction, closed coupled type, with integral hair and lint strainer.
   b. The pump body, seal plate, and attached hair and lint strainer must be constructed of non-corrosive PPO Resin materials, and close-coupled to an electric motor by means of an adaptor of the same material.
   c. The pump must have a PPO Resin diffuser to aid in priming and it must contain a replaceable bronze wear ring for the impeller. The impeller must be of the closed type and PPO Resin, non-overloading at points on the performance curve. The mechanical shaft seal must be constructed of ceramic and carbon seal faces, with stainless-steel, brass, and Buna N materials in the spring bellows portion. The impeller must be secured to the motor shaft by means of a stainless-steel key and locking screw into the end of the motor shaft. The pump must be capable of operating at up to 50 psi, 104° F continuous water temperature.
   d. The electric motor coupled to the pump must be of the NEMA Rated series JM construction with stainless-steel shaft inside a removable shaft sleeve of 300 series stainless-steel. Motors must be continuous duty rated at 40° C (or realign better) ambient and be suitable for outdoor installation.
   e. Pumps must meet Department of Energy (DOE) minimum efficiency standards for dedicated-purpose pool pump (DPPP) motors.
   f. The pump strainer must consist of a PPO Resin body, Polycarbonate Resin Thermoplastic cover with O-ring seal, and Cam and Ramp Lid, and a strainer basket of mineral reinforced polypropylene material.
   g. The strainer basket must be securely positioned below the suction inlet of the trap, with access for inspection and cleaning through a removable trap body lid. The trap body lid must be secured by means of a locking ring. Provide one spare basket for each strainer.
9. Other System Pumps and Motors
   a. Provide one (1) portable utility pump(s). The pump(s) must be a 1 HP, 3600 RPM, 115/230-volt, 1 phase, 60 cycle unit capable of 60 GPM at 25 ft. TDH.
      1) Basis of Design: Pump must be a Godwin GSP10 or approved equal.

B. Variable Frequency Drive Starters
1. Provide variable frequency drive starters (VFD) for the pool pumps as indicated on the drawings. VFDs must be Eco-Flow-C by H2Flow Controls, AcuDrive by Pentair, GreenDrive by Neptune Benson, or approved equal.
   a. Basis of Design: Eco-Flow-C by H2Flow Controls
2. Ensure that equipment is provided with the correct operating voltage and that interconnected electrical and electronic equipment must adequately communicate and operate the specified pumping equipment. Equipment installations must meet or exceed the requirements of the National Electric Code and other local and state regulations.
3. Variable Frequency Drive Base Requirements
   a. Provide complete VFD as specified herein or in the equipment schedule for loads designated that must be variable speed or variable flow.

b. The VFD must convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD must be a six or twelve pulse input design, and the input voltage rectifier must employ a full wave diode bridge. The output waveform must closely approximate a sine wave. The VFD must be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.
c. Indoor Applications: VFD must be fully enclosed in a corrosion resistant NEMA 12/IP54 UL listed enclosure.
d. VFD and required options will be incorporated by the VFD manufacturer into an integrated package, with a single input feed and main disconnect.
e. VFD must have a fused disconnect and battery back-up, for the purpose of maintaining programming in the event of a power outage, or properly rated circuit breaker.
f. The VFD must produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.
g. The VFD selected must be able to source the motor's full load nameplate amperage (fundamental RMS) on a continuous basis and be capable of running the motor at its nameplate RPM, voltage, current, and slip.
h. The VFD will be capable of running variable torque loads. The VFD must be able to provide its full-rate output current continuously and 110% of rated current for 60 seconds.
i. VFD must offer a motor spinning test that will allow the user to determine if the motor is running in the correct direction.
j. Switching of the input power to the VFD must be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.
k. Switching of power on the output side between the VFD and the motor must be possible with no limitation or damage to the VFD and must require no additional interlocks.
l. Cooling must be via an aluminum heat sink and must prevent the introduction of ambient air to the electronics for cooling. With the exception of the water-resistant heat sink fan, electronics must be fully sealed within the enclosure.
m. The VFD must have temperature-controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.
n. VFD must provide full torque to the motor, given input voltage fluctuations of up to +10% to -10% of the rated input voltage.
o. The VFD must include additional contacts for interface with a remote start/stop panel and the emergency stop function. When the VFD is supplied for a spa hydrotherapy pump, the drive must also interface with a remote timer switch to control pump operation via a preset timed duration (15-minute timer switch).

4. Harmonics:
   a. The VFD must provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor.
   b. The VFD must be provided with line-side harmonic reduction, as required, to ensure that the current distortion limits, as defined in table 10.3 of IEEE 519-1992, are met.
   c. Harmonic solutions must be capable of withstanding up to 2% ambient voltage distortion with the maximum Current Distortion not to exceed 12% at 100% load.
5. Protective Features:
   a. VFD must have input surge protection.

b. VFD must include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
c. Printed Circuit boards must be conformal coated to reduce the corrosion effect from environmental gases and other conditions. The conformal coating must meet IEC 61721-3-3, Class 3C2 as standard.
d. Dry-pump detection must be available to detect if the pump has run dry. If this condition occurs, the drive will be safely stopped. A timer must be included to prevent nuisance tripping.
e. VFD must include two current sensors on output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

6. Interface Features:
   a. VFD must provide an alphanumeric backlit display keypad (LCP) which may be remotely mounted using a standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
   b. VFD Display must have the ability to display parameters pertaining to the VFD or the load including the following: current, speed, DC bus voltage, output voltage, input signal in mA, or other values from a list of user-selectable parameters.
   c. LED lights must be provided. These indications must be visible both on the keypad and on the VFD when the keypad is removed.
   d. Two-level password protection must be provided to prevent unauthorized changes to the programming of the VFD.
   e. VFD must offer as standard an internal clock. The internal clock can be used for: Timed Actions, Energy Meter, Trend Analysis, date/time stamps on alarms, Logged data, Preventive maintenance, or other uses.
   f. A battery back-up must be provided to maintain internal clock operation during power interruptions.
   g. Inputs and outputs must be optically isolated.
   h. The VFD must have at least two analog signal inputs. Inputs must be programmable for either 0 -10V or 0/4-20 mA.
   i. At least one programmable analog output must be provided for indication of the drive status. This output must be programmable for output speed, voltage, frequency, motor current and output power. The analog output signal must be 0/4-20 mA.
   j. The VFD must be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
   k. The VFD must be equipped with a standard RS-485 serial communications network connection.
7. Adjustments:
   a. The VFD must have selectable output switching frequencies to mitigate motor noise.
   b. Multiple complete programming parameter setups must be provided, which can be locally selected through the keypad or remotely selected via digital input(s), allowing the VFD to program for up to four alternate control scenarios without requiring parameter changes.
   c. In each programming setup, independent acceleration and deceleration ramps must be provided. Acceleration and deceleration time must be adjustable over the range from 0 to 3,600 seconds to base speed.

d. The VFD must have four programmable “Bypass frequencies” with adjustable bandwidths to prevent the driven equipment from running at a mechanically resonant frequency. The feature must offer a Semi-Automatic program to simplify the set-up.
e. VFD must include an automatic acceleration and deceleration ramp-time function to prevent nuisance tripping and simplify start-up.
f. The VFD will include a user-selectable Reset function, which enables the selection of between zero and multiple restart attempts after a self-clearing fault condition (under-voltage, over-voltage, current limit, inverter overload, and motor overload). The time between restart attempts must be adjustable from 0 through 600 seconds.
g. The VFD will include a user-selectable Auto-Restart function that enables the VFD to power up in a running condition after a power loss, to prevent the need to manually reset and restart the VFD.

8. Bypass
   a. Provide a manual bypass in conjunction with the VFD for the recirculation pump(s) and feature pump(s) consisting of a door interlocked main pad lockable disconnect in the off position, a built-in motor starter and a facility for allowing DRIVE/OFF/BYPASS/TEST switching by three contactor control.
9. Individual VFD options such as bypass, motor selection contactors, etc. must be incorporated by the manufacturer onto a single panel with a single input feed and main disconnect function. Enclosures must be UL listed and fully assembled by the VFD manufacturer.
10. Service Conditions:
    a. The ambient operating temperature of the VFD must be -10ºC to 40ºC (14 to 104°F).
    b. Elevation to 3,300 feet (1000 meters) without derating.
    c. VFD’s must be rated for line voltage of 525 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with +10% to -10% variations. Line frequency variation of ± 2% is acceptable.

C. Pump Gauges
1. Pressure gauges must be provided on the discharge of the pumps.
2. Compound gauges must be provided at the intake port of the pumps, after the hair and lint strainer.
3. Gauges must be liquid filled, 316L stainless-steel bourdon tube type with a minimum 2-1/2-inch diameter dial, high impact polypropylene or stainless-steel case, corrosion resistant white scale with black divisions and numerals, 300 Series stainless-steel heavy duty rotary bushed movement, black enameled balanced Micrometer pointer.
   a. Basis of Design: Gauges must be manufactured by Weksler Instrument Corporation or approved equal.
4. Scale ranges must be selected to indicate the normal system operating pressure of each system or location within the system. Pressure ranges must be calibrated in psig (0-60 psi) and compound gauge must be calibrated in inches of mercury (0-30 in Hg / 0-60 psi).
5. A stainless-steel filter type pressure snubber must be provided for each pressure gauge consisting of a 3/8-inch diameter by 1/8-inch-thick micro metallic stainless-steel filter and placed in the line just before the pressure gauge. Provide isolation brass valves or brass gauge cocks at each gauge for easy replacement and maintenance.

D. Pump Hoist Beam Trolley: Provide CM Series 632 close radius trolley by CM Industrial must be mounted on hoist I-beam at pool pump pit (refer to structural). Trolley must be sized

adequately to provide hoist capabilities for pump/motor combinations located in the pump pit. Provide with double row ball bearing wheel design, bearings pre-packed with lifetime lubricant. Confirm trolley size is compatible with beam configuration. Minimum rated capacity of 2 tons.

2.3 FILTRATION EQUIPMENT

A. The filter system must consist of high-rate pressure sand filter tanks as shown on the drawings. Every aspect and component of the filter system must be certified by the National Sanitation Foundation (NSF) and bear the certification mark. The filter must have an engraved metal data plate permanently affixed on the face of the system that describes operational data and instructions and indicates startup date.

B. It is the intent of these specifications to describe a filtration system complete in every respect with accessory items and supplied and warranted by one manufacturer.

C. Horizontally Oriented Fiberglass Tanks
   1. The filter tanks must be horizontally oriented single cell fiberglass tanks, minimum 48 inches in diameter. The filter system must be listed as approved by the National Sanitation Foundation prior to bid date.
      a. Basis of Design: Fiberglass filters must be the product of Stark/Pentair, Waterco, or Neptune Benson provided they meet the specifications and layout. System design is based upon Neptune-Benson. Valves must be provided to backwash one filter at a time.
   2. Filter tanks must incorporate components and features as described in this section.
   3. Two (2) saddle style bases must be provided for tank support. Systems that incorporate stacked tanks must include similar bases and mounting saddles for the upper vessel. Tank supports and connections must be seismic rated to support the filter tank(s) for the appropriate seismic zone where the project is located. Access to the tank must be provided by a 14" x 18" manhole with two (2) curved yokes. Manhole seal must be complete with a one-piece 1/4" neoprene gasket and positioned so that internal pressure from the filter will augment the seal. No additional hardware or through bolts will be allowed.
   4. Each filter tank must be equipped with the necessary flanges and connections for the internal and external piping. Connections must be comprised of fiberglass flanges and schedule 80 PVC flanges.
   5. Tank connections 2 inches and smaller must be 150 lb. Type 316L stainless-steel threaded full couplings. Tank connections 3 inches and larger must be heavy steel bosses drilled and tapped on both sides to receive standard flanged fittings or Sch. 40 Type 316L stainless-steel nipples.
   6. The discharge from the automatic air release valve must be hard piped to waste. Each filter tank must have a means of releasing air. Each coupling or orifice must be provided with a slotted PVC sand retainer or stainless-steel strainer. An automatic air release system must be provided for each tank.
   7. The drain system must consist of a 3/4-inch 316L stainless-steel coupling mounted at the lowest point in the bottom head. This drain must be valved and piped to the nearest floor drain or backwash pit.
   8. Filter Piping - Internal
      a. The lower internal distribution system must be a horizontal header/lateral arrangement. The header must be Schedule 80 PVC construction, capped on one end and flanged or threaded at the other end for field connection. Lateral connections must be spaced no more than 6 inches on centers and must be 1-1/2-inch FPT connections. Attachments to header must be solvent welded and thermo-welded to ensure integrity of connection.

b. Under drain system must be factory installed and constructed of extra heavy Schedule 80 high impact PVC. Multiple PVC main headers must be tapped and threaded to receive laterals.
c. Laterals must consist of 1-1/2-inch Schedule 80 PVC pipe with openings as required. Each lateral must be fabricated complete with socket cap on one end and male adapter on the other end. Both fittings must be solvent welded to the slotted pipe. Laterals must be designed and sized at the factory, so they are installed in the field and over the entire cross sections area of the filter.
d. The upper distributor must consist of PVC piping Schedule 80 and/or deflector plate per manufacturer standard design.
e. Each filter must be supplied with a pressure equalizing upper internal distribution system consisting of a horizontal header/lateral arrangement. The header piping must be constructed of Schedule 80 PVC. The header/lateral piping and connections must be designed and sized to provide uniform distribution and unrestricted flow during the filtration and backwash cycles.
f. Upper laterals must be constructed of Schedule 80 PVC pipe with machine slotted openings or orifices. Machined slots or orifices must be clean, de-burred and free of obstructions that would not permit the free flow of water through the opening. Details of the lateral attachment to the header must be submitted for review and approval.
g. The lower and upper distribution systems must be properly supported and anchored. Hardware in wetted areas must be Type 316L stainless-steel or non-metallic. Tank interiors must be inspected prior to the media being placed in the filters.

9. Filter Piping - External (Face)
a. External face piping must be Schedule 80 PVC pipe and fittings. Flanges must be located so as to allow for easy dismantling of face piping. Fittings must be solvent cemented.
b. Piping must be drilled and tapped where necessary to accommodate gauge tubing connectors.
c. Valves 3" and larger must be constructed with cast aluminum S12A alloy (as defined by ASTM B275) housing and fully coated with Rilsan on interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and 316L stainless-steel shaft. Valves must be rated for 150 psi bubble tight shutoff. Unless otherwise specified, nuts and bolts must be stainless-steel with stainless-steel washers and used when secured to PVC flanges. Systems incorporating solenoid, pneumatic, pressure amplified, hydraulic or multi-directional valves are not acceptable.
d. Standard accessory items must include sight glass rated for 50 psi with polycarbonate glass, remote mounted gauge panel with two 4½" diameter pressure gauges, ¼" petcocks, ¼" poly vent tubing with PVC compression adapters.

10. Backwash Control
a. The filter manifold face piping must be designed to allow for one (1) filter tank to backwash at a time while the recirculation system is operating. A manual backwashing system must be provided with the filter system.
b. Manual Backwash System
1) The manual backwash system must be equipped with a face piping configuration such that the operator must manually control and operate both the time and sequencing of the backwash cycle. Valving on the filter face piping must be a mechanical linkage device allowing the operator to

simultaneously move two (2) valves at once. Mechanical linkage components must be PVC or Type 316L Stainless-steel.

11. Automatic Air Relief Valve
    a. A 1” valve must be provided to automatically and continuously release air in the filter. The valve must be fabricated of plastic with Buna-N seals. A plumbing kit must be provided with two (2) PVC ball valves to allow manual air relief and isolation of the automatic valve. Valves fabricated of cast iron, bronze or stainless-steel valves will not be accepted.
12. Filter Media
    a. Filter media must be a carefully selected grade of hard uniformly graded silica material. Media must be milled angular shaped particles of silica quartz. The filter sand must have a particle size between 0.45 mm and 0.55 mm and have a uniformity coefficient not to exceed 1.53. Specific gravity must not be less than 2.5 with a pH of 7.0.
    b. Media (sand) must be cleaned and free from clay or limestone deposits. The bottom layer of support media must be placed by hand to avoid damage to the under-drain system and leveled before the addition of the upper layer of filter media.
    c. Media must be delivered after approval by the manufacturer of the filter and stored in 100-pound bags for ease of handling and elimination of possible contamination.
    d. Media must be supplied by the filter manufacturer and approved by the filter manufacturer prior to shipping.
13. Support Media
    a. A Gravel support media of a hard-coarse aggregate with a sub-angular grain shape with a particle size of 1/8" x 1/4" must be used on the inside of the bottom head to the elevation where the filter media commences. The specific gravity must not be less than 2.5. Support media must be placed by hand to avoid damage to the underdrain system and leveled before the addition of the upper layer of filter media. Concrete under fill is not recommended. Support gravel must be delivered and stored in 100-pound bags (approximately one cubic foot) for ease of handling and elimination of possible contamination. Media must be free from minerals which can precipitate onto pool surfaces.
    b. Sand must be a carefully selected grade of hard, uniformly graded silica material. Media must be naturally rounded particles of silica or milled angularly shaped particles of silica quartz. Sand must have a particle size between 0.45mm and 0.55 mm (#20). No more than 1.5% is allowed to pass through a #40 sieve (.0164”). Uniformity coefficient must not exceed 1.53. Specific gravity must be not less than 2.5. The filter must contain a minimum bed depth as recommended by the manufacturer. Systems which do not provide a minimum bed depth will not be accepted. Sand must be delivered and stored in 100-pound bags (approximately one cubic foot) for ease of handling and elimination of possible contamination. Media must be free from minerals which can precipitate onto pool surfaces.

2.4 RECIRCULATION FITTINGS

A. Main drains must be PVC/Fiberglass box with PVC grating as sized on the drawings. Grate openings must not exceed 11/32 inch in width, providing an open flow area to allow water velocity not to exceed 1.5 fps. The grate must be PVC and fit closely and flush with top surface of frame and secured to frame with vandal proof fasteners. Provide a no-leak seal flange at the midpoint of the boxes. The exposed edges of main outlets must be rounded

and smooth, free of burrs and sharp edges. Main drain covers must comply with the Virginia Graeme Baker Act and ANSI/APSP-16 2017. Project specific shop drawings detailing piping port locations and sizes on each side of the main drain sump must be provided for each sump. Shop drawings must show port locations with caps/flanges to allow for testing.

B. Provide a water bonding fitting PB-SK-20 manufactured by Perma-cast Swimming Pool Products or approved equal. Bonding fitting must be installed at the lowest point of the main drains.

C. Provide hydrostatic relief valves consisting of a 2” cycolac relief valve connected to an FPT commercial style Schedule 80 PVC collector tube. The collection tube must have seepage holes, 3/8 inch in diameter, and must be screwed securely to the valve body. The hydrostatic relief valve must be designed to seal with minimum pressure and must have a non-plugging, self-cleaning raised valve seat. The hydrostatic relief valve must be Hayward model #SP1056 with collector tube model #SP1055, Aquastar model #HVC101 or approved equal.

D. Concrete dropout boxes (converters) must be concrete sumps with 12-gauge 316L stainless-steel frame and sized as shown on the plans. Provide a no-leak seal flange at the midpoint of the boxes.

E. Wall inlet fittings must be cycolac directional inlet Hayward model #SP-1419-D (3/4” opening) mounted in model #SP-1022S, Aquastar model #3301B (3/4” opening) or approved equal from Sta-Rite.

F. Adjustable floor inlet fittings must be provided each consisting of an ABS plastic body and adjusting top plate with a positive locking device. A spanner wrench must be provided to facilitate flow adjustment. The inlet body must be provided with a 2-inch cycolac solvent weld connection and internal NPT threads to facilitate line pressure testing. Floor inlet fittings must be Sta-Rite model #8417-0000-white/#8417-0100-gray/#8417-0200-black, Aquastar model #4DIV101(white)/ #4DIV102(black)/ #4DIV103 (gray) or approved equal.

G. The sight sump frame and cover must provide access to the vertical sight sump standpipe as indicated in the plans. Frame and cover must be provided as a pan-filled, removable access lid that can receive the surrounding deck finish. Lids must be model #SQ201 PAL (Tan), #SQ201 PAL (Gray) or #SQ201 PAL (Frosted) manufactured by Pour-A-Lid or approved equal. Refer to the Owner/Architect for color selection.

H. Valve Box
   1. Valve box cover(s) that are not specified on the drawings or specifically identified as another size or material must be a solid HDPE lid(s) by Daldorado or approved equal. Access covers must be sized as shown on the drawings and be constructed of 1” thick marine grade HDPE with a slip resistant surface. Valve box must be provided with a 3” x 3” x ¼” FRP I-beam across the center of the opening as shown on the drawings. The valve box cover must come with corrosion resistant hardware to secure the hatch. The access cover must have an identification plate with 1.5” high font identifying the contents below the cover. Refer to the Owner/Architect for color selection.

I. Anti-vortex plates must be provided at the suction points of the main recirculation pump(s) in the surge tank(s). Each plate must be connected to the suction pipe via a PVC flange and must be ½ in. thick with minimum dimension of at least 2.5 times the connecting pipe diameter. The plate must be located 4 inches above the finished floor of the surge tank. Four (4) 3/4 in. stainless-steel threaded rods, nuts, anchor bolts and washers must be used to fix the offset

distance and provide a secure base for the suction pipe. Manufactured fiberglass or PVC anti-vortex plates by Daldorado, Neptune-Benson or approved equal.

J. Hydrotherapy inlet fittings must be provided consisting of a cast bronze or cycolac venturi body with 1-1/2-inch water inlet pipe connections and 1/2-inch air intake connection. A 1/8-inch IPS thread must be provided in the inlet throat to permit hydrostatic pressure testing of the piping system. The inlet must be designed to operate at 20 GPM at a working pressure of 15 PSI and installed as shown on the drawings. Jet Body must be Waterway model #210-5950 with Waterway Adjustable Fitting model #210-8750 or approved equal. Provide fitting adjustment tool from Waterway, model #210-1770A, or approved equal.

2.5 PIPING SYSTEMS

A. General
1. Provide recirculating piping between the pool(s) and the pool mechanical room, fill funnel and all interconnecting piping to and from the chemical feed systems and chemical controller.
2. Provide necessary pipe supports and support systems required to support associated piping and valves.
3. Provide other tubing, conduit or piping associated with equipment specified herein. Coordinate with other trades.

B. Pipes
1. Pipe routing as shown and detailed on the contract drawings is diagrammatic only and is not intended to show minor details or exact locations of piping systems. Installation is required and must be adjusted to accommodate interference and adjustments anticipated and encountered. Pipe sizes on plans refer to the nominal inside diameter of the pipe.
2. PVC swimming pool piping must be NSF approved and conform to the requirements of ASTM D-1785.
3. PVC pipes must be the product of one manufacturer. Approved manufacturers of PVC piping are Eslon, Harvel, and Chemtrol or approved equal.
4. The swimming pool piping above and below the floor in the pool mechanical room must be Schedule 80 PVC.
5. The swimming pool piping under the pool floor must be NSF approved, Schedule 40 PVC and concrete encased. Transitions between Schedule 40 and Schedule 80 must be encased in concrete.
6. Below grade swimming pool piping not located beneath the pool floor must be Schedule 80 PVC backfilled with native granular material free of ice, clay, debris, organic matter, and rocks larger than 4" across their greatest dimension, and per recommendations indicated in the project geotechnical report.
7. The influent and effluent lines to the heat source unit must be CPVC. Connections between metallic piping and/or equipment and PVC must be flanged.
8. PVC and CPVC fittings must be the product of one manufacturer. Molded fittings must be manufactured by Ipex, Chemtrol, Harvel, Spears, and Lasco/Westlake or acceptable substitutes. Fabricated fittings must be manufactured by Harrison Machine, Spears, or an acceptable substitute.
9. Vertical sight sump piping must be NSF approved, Schedule 40 PVC. Horizontal sight sump piping must be NSF approved, Schedule 40 PVC that is perforated and wrapped with fabric and has 3/8” diameter holes located top and bottom on 4 inch or 6-inch centers. Horizontal sight sump piping must extend 1 foot minimum beyond the main drain.

10. Chemical feed lines from chemical feeders to recirculation piping must be Schedule 80 PVC piping. Piping must be hard piped into the recirculation piping via tee or saddle per the drawings. Required valves must be of PVC construction.
11. Splash collar(s) for the fill funnel(s) must be clear Schedule 80 PVC and manufactured from a Type I, Grade I PVC compound with a Cell Classification of 12454 per ASTM D1784. The pipe must be manufactured in compliance with ASTM D1785.
12. Y-strainers for piping sized 4” or smaller must be Hayward YS Series strainers with FPM O-rings or approved equal. Y-Strainers for piping sized 6” or larger must be Fluidtrol WYE Series strainers with EPDM gaskets or approved equal. Provide an extra perforated screen with each strainer.
13. Flanged plumbing connection hardware must be stainless-steel.
14. Materials must be installed by workmen thoroughly skilled in their trades and work must present a neat and mechanical appearance when complete. At no additional expense to the Owner, replace or correct work not judged acceptable by the Architect, Engineer, or Owner’s representation.
15. Support hardware, brackets, fasteners, hangers, etc. furnished and installed in the surge tank must be 316L stainless-steel.
16. No installation allowed that will provide a cross-connection or interconnection between a distributing supply for drinking purposes and the swimming pool, or between the pool and a sanitary or storm water sewer system that will permit a backflow of water into the pool water system.
17. Piping must be hydrostatically (water) pressure tested for leaks before and after backfilling to guarantee water tightness. Pneumatic (air) pressure test is not allowed.
18. Provide water seals for watertight penetrations of concrete walls and floor slabs.
    a. Pool Concrete: Water seals must be coupling or sleeve type with a thermo welded or molded flange and the O.D. must be sized to 150% of the O.D. of the pipe. The thermo-welded type must be welded from both sides. Water seals must be located at the centerline of the wall or slab being penetrated prior to placing the concrete to assure a watertight seal. Manufactured fiberglass and PVC water seal fittings by A.S.A. Manufacturing, Aqualogic or approved equal.
    b. Pump Pit: Link seals must be provided in the sizes and quantities shown on the drawings and installed to provide flexible watertight penetration. Metal parts must be made of 316L stainless-steel. Links must form a continuous rubber seal that is tightened with a series of stainless-steel bolts to form a watertight seal. Link seals must be manufactured by GPT, Calpico Inc. or an approved equal. Xypex Patch’n Plug or approved equal must be used to seal pipe penetration. Link seals must be installed with either a cored hole or a Century Line pipe sleeve.
    c. Surge Tank: Water seals must be coupling type with a thermo welded or molded flange and the O.D. must be sized to 150% of the O.D. of the pipe. The thermo-welded type must be welded from both sides. Water seals must be located at the centerline of the wall or slab being penetrated prior to placing the concrete to assure a watertight seal. Manufactured fiberglass and PVC water seal fittings by A.S.A. Manufacturing, Aqualogic or approved equal. Link seals are also acceptable with a cored hole or a Century Line pipe sleeve.
19. Adhere to the applicable provisions in Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.
20. Mechanical equipment must be connected into the recirculation piping system must be connected utilizing flanged or union connections.
21. Provisions must be made to purge pipes in the system.
22. Concentric reducers must be fiberglass by MerMade Filter, Inc., or equivalent reducers of schedule 80 PVC construction.

C. Pipe Hangers and Supports
   1. Manufacturer
      a. Subject to compliance with these specifications, pipe hanger and support systems must be manufactured by Cooper B-line (basis of design), Inc, TOLCO, and Anvil International or approved equal.
   2. Hangers
      a. Pipes 2 inches and smaller
         1) Adjustable steel clevis hanger, B-Line models B3100 or B3104.
         2) Adjustable steel swivel ring (band type) hanger, B-Line model B3170.
      b. Pipes 2-1/2 inches and larger
         1) Adjustable steel clevis hanger, B-Line model B3100.
         2) Adjustable steel yoke pipe roll, B-Line model B3114.
   3. Multiple or Trapeze Hangers
      a. Trapeze hangers must be constructed from 12-gauge roll formed ASTM A1011 SS, Grade 33 structural steel channel, 1-5/8 by 1-5/8-inch minimum, B-Line B22 strut or stronger as required.
      b. Mount pipes to trapeze with 2-piece pipe straps sized for outside diameter of pipe, B-Line B-2000 series.
   4. Wall Supports
      a. Pipes 2-1/2 inches and smaller
         1) Steel offset “J” hook hanger, B-Line model B3600.
      b. Pipes 3 inches and larger
         1) Welded strut bracket and pipe straps, B-Line models B3064 and B2000 series.
         2) Welded steel bracket B-Line model B3066 or B3067 with roller chair or adjustable steel yoke pipe roll. B-Line model B3120 or B3110.
   5. Floor Supports
      a. Electroplated carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. B-Line model B3092 and B3088T or B3090 and B8088. Pipe saddle must be screwed or welded to an appropriate base stand.
   6. Vertical Supports
      a. Steel riser clamp sized to outside diameter of pipe, B-Line model B3373.
   7. Plastic Pipe Supports
      a. V-Bottom clevis hangers with galvanized 18-gauge continuous support channel, B-Line models B3106 and B3106V, to form a continuous support system for plastic pipes smaller than 1 inch or flexible tubing.
      b. A vented and sloped continuous PVC Schedule 40 pipe no smaller than 1-1/2 inch outside diameter will be used to route flexible tubing with the appropriate pipe supports.
   8. Supplementary Structural Supports - Design and fabricate supports using structural quality steel bolted framing materials. Channels must be roll formed, 12-gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch or greater as required by loading conditions. Submit design for pipe tunnels, pipe galleries etc. for approval. Use clamps and fittings designed for use with the strut system.

D. Hanger Attachments
   1. Upper Attachments
      a. Beam Clamps
         1) Beam clamps must be used where piping must be suspended from building steel. Clamp type must be selected on the basis of load supported and load configuration.

2) C-Clamps must be locknuts and cup point set screws similar to B-Line model B351L or B3036L. Top flange c-clamps must be used when attaching a hanger rod to the flange of structural steel, B-Line model B3034 or B3033 or approved equal. Refer to manufacturer's recommendations for set screw torque. Retaining straps must be used to maintain the clamp position on the beam where required.
3) Center load beam clamps must be used where specified. The steel clamps must be B-Line models B3050 or B3055. Forged steel beam clamps with cross bolt must be B-Line B3291-B3297 series or approved equal as required to fit beams.

b. Concrete Inserts
1) Cast in place spot concrete inserts must be used applicable, either steel or malleable iron body, B-line B2500 or B3014 or approved equal. Spot inserts must allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rods sizes, B-line models N2500 or B3014N series.
2) Continuous concrete inserts must be used where applicable. Channels must be 12 gauge, ASTM A1011 Grade 33 structural quality carbon steel, complete with Styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert must have a load rating of 2,000 lbs/ft. in concrete, B-Line models B22I, 32I, or 52I or approved equal. Select channel nuts suitable for strut and rod sizes.

E. Hanger Accessories
1. Hanger rods must be threaded on both ends or continuously threaded rods of circular cross section. Use adjustable lock nuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

F. Hanger Finish
1. Indoor Finishes
a. Hangers must be zinc plated in accordance with ASTM B633 or must have an electro-deposited green epoxy finish.
b. Strut channels must be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 or must have an electro-deposited green epoxy finish.
c. Zinc Plated hardware is not acceptable for use in chemical rooms.

G. Valves
1. Valves 3 inches and larger must be butterfly type valves, with PVC body, 150# SWP with stainless-steel shaft, PVC or polypropylene disc and replaceable resilient seat bonded to a rigid shaft and guaranteed for bubble tight shutoff from 27-inch vacuum to 150 PSI. Extended neck 2 inches beyond flanges for insulated piping must be provided with handle for manual operation. Valve components must be suitable for swimming pool chlorinated water service. Butterfly valves must be Georg Fischer Type 567, Asahi/America Type SP Pool-Pro, Chemtrol Model-B, Simtech VP series, Colonial Valve 411 Series, or approved equal.
2. Valves smaller than 3 inches must be PVC true union ball valves, full port, three-piece construction, blowout-proof stem, Viton seal with socket end connectors.
3. Check valves must be a quick closing non-slam type, either self-aligning wafer or flanged type, of corrosion resistant materials suitable for use in a swimming pool environment. Provide check valves in accordance with the manufacturer's recommendations. Locate check valves at least 5 pipe diameters from pumps and fittings. Check valves must be Technocheck Corp., model 5050, with epoxy coated cast

iron body and bronze swing plates on a stainless-steel spring, Colonial Valve model 601N or 601NP PVC valve with EPDM O-ring and stainless-steel spring or approved equal, for installation between 150 lb. flanges.

4. Modulating float valve in the surge tank(s) must have PVC body and stainless-steel wafer disc. Hardware must be non-corrodible. The float-operated valves must be provided horizontally on the main drain lines in the surge tank(s). A valve must consist of non-corrosion components including shaft, float arm, pins, and floats. Valve must be suitable for mounting on a 125E class standard PVC flange. The float arm leverage weight and pivot lengths must be adjustable to obtain desired ratio of surge tank level change to pool gutter overflow level change. Two floats and a stabilizer required. Valve must be model FV-D XWB (Extra Weight Ball) as manufactured by MerMade Filter, Inc. or approved equal manufactured by Neptune-Benson, EPD, or Fluidtrol Process Technologies, Inc.
5. Submerged valves up to 3 inches must be PVC true union ball valves. Submerged valves over 3 inches must be PVC bodied, wafer type, butterfly valves with stainless-steel handle extensions as required. Valves must be by approved manufacturers listed above. Submerged valves must be provided with stainless-steel connectors. The stem housing extensions must be properly supported and braced.
6. Butterfly type valves 8 inches and larger must be fitted with a watertight gear operator.
7. Valves located 7 feet or greater off the floor must be fitted with a chain operator.
8. Submerged valves, valves buried below grade, or valves not readily accessible, must be provided with a stainless-steel reach rod and handle.
9. Valve hardware must be 316L stainless-steel and meet ANSI hardware installation guidelines.

H. Pipe and Valve Identification

1. Exposed pool piping must be equipped with color coded flow directional arrows at thirty (30) inch intervals per local and state swimming pool health code. Verify that pool piping identification is in accordance with local and state health regulations.
2. Valves must be identified with minimum 1-1/2-inch diameter plastic laminate engraved tags with minimum 1/2-inch-high numbers. Tags must be fastened to valves with a nylon attachment (zip tie). Valves must be described as to their function and referenced in the operating instruction manual and wall mounted piping diagram that must be prepared.

2.6 CHEMICAL TREATMENT SYSTEMS

A. Calcium Hypochlorite (Chlorine Tablets)

1. Shop drawings complete with a piping diagram depicting the location in which the dry chlorination feeder is connected to the system must be provided and approved prior to installation. Installation of the system must be as specified in the manufacturer’s directions with no exceptions taken. Provide either of the calcium hypochlorite systems specified in this section that meets the capacity requirements shown on the drawings.
2. A factory-authorized representative must provide training to the owner and the training must be video recorded.
3. Accu-Tab PowerBase
   a. General Description
      1) The system must be designed to feed low concentrations of calcium hypochlorite in solution intermittently or continuously as required for pool applications. The system must be a single pre-assembled, package unit with a welded aluminum frame consisting of chlorinator, electrical box, centrifugal pump, and solution tank for ease of installation and operation.

The system must be the Accu-Tab PowerBase. Only Accu-Tab Blue SI calcium hypochlorite tablets must be used, the patented blue colorant added for safety (to help prevent accidental mixing with other chemicals).

2) The system must use an NSF Standard 50 listed erosion feeder and tablet combination and must be capable of meeting the requirements of the Health Department having jurisdiction over the installation.

b. System Features
   1) A maximum chlorine solution level of 0.05% (500 ppm) must be maintained to prevent calcification in system components. Systems producing chlorine concentrations higher than 0.05% are not acceptable.
   2) Delivery must be by erosion feed technology to control accurate and consistent concentration limits in the chlorine treatment solution. Soaking type, spray, and/or vortex technology systems are not acceptable.
   3) The chlorinator must automatically and continuously feed a limited quantity of chlorine in solution as needed; when the system is not running, no more chlorine than that amount which can be fed in one minute or less must be left in the tank to prevent dilution. Batch systems preparing excess quantities of solution for delivery over an extended period are not acceptable.
   4) A centrifugal pump wired to the system electrical box must feed freshly mixed chlorine treatment solution only as required for maximum efficiency. Batch systems requiring the use of a metering pump or pumps to feed pre-prepared standing solution are not acceptable.
   5) Piping in the chlorinator unit must be Schedule 40 PVC. Systems with flexible tubing are not acceptable.

c. System Components
   1) Accu-Tab PowerBase chlorinators are designed exclusively for Accu-Tab Blue SI calcium hypochlorite tablets. Tablets are placed on a sieve plate inside the chlorinator; as water flows across the sieve plate, the tablets erode at a rate proportional to the flow rate.
   2) Inlet Water Supply Connection.
      a) Model 1030: 1.5” (water supply of 10 GPM required)
   3) Inlet Water Filter: A filter to protect chlorinator components from start-up debris and sand from broken filter laterals.
   4) Flow Meter:
      a) A rotameter flow meter, measuring the flow of the water-eroding stream to the chlorinator. (For models 1030, 3070AT, 3140AT)
      b) Clamp-on flow meter, measuring the flow of the water-dissolving stream to the chlorinator. (For model 3500)
   5) Solution Tank: PowerBase 3500 made of HDPE; others made of PVC.
   6) Capacities:
      a) Model 1030: 7 gallons
   7) Primary Solution Tank Level Control: Made from Schedule 80 PVC and 316L stainless-steel. The float valve opens to maintain the pump rate as it is manually throttled.
   8) Overflow Protection: Two (2) level switches in the upper portion of the solution tank will run the pump from high to lower level to prevent system overflow.
   9) Solution Delivery Pump: Delivers chlorinated solution to the return line. A single-stage centrifugal pump is provided for systems with pressures up to 20 PSIG.

10) Primary Backflow Prevention: A PVC swing check valve prevents reverse flow of water into the system.
11) Discharge Control Valve (manual): PVC gate valve allows operator to adjust flow of solution to the system.
12) Outlet Connection:
    a) Model 1030: 1”
13) Aluminum Frame: Type 6061-T.
14) NEMA 4X Electrical Enclosure

4. Pulsar System
   a. The sanitization system for the pool(s) must be a Pulsar system and must operate in a non-pressurized manner to ensure optimum safety and ease of operation.
   b. A post filter recirculation loop will be added to the main pool recirculation system to supply the chlorination system. The recirculation loop will provide the inlet water supply to the chlorinator as well as the vacuum to evacuate the chlorinated solution.
   c. The sanitization system must be N.S.F. listed.
   d. The sanitization system must incorporate the principle of High-Capacity Erosion (HCE) technology. Water must rise through the grid of briquette basket from the force of an upward facing nozzle contacting the Pulsar Plus Dry Chlorinator Briquettes. The briquettes must be in contact with the water for a period of time creating a chlorinated solution which will exit the dissolving bowl at a specific height and fall into the discharge tank by gravity. The chlorinated solution must be drawn by the vacuum from the discharge tank and introduced into the recirculation system. The output must operate with a vacuum range between 5” and 29” Hg.
   e. The vacuum is created by a Mazzei venturi, model 1585X, which is installed in the post filter recirculation loop driven by a Pulsar booster pump. The venturi is installed on the discharge side of the Pulsar pump creating a flow though the venturi, which provides suction on the discharge valve evacuating the discharge tank. An emergency overflow switch must ensure that water flow to the spray manifold is shut off in the unlikely event that the discharge tank has not emptied properly.
   f. Pulsar Precision: The system will operate with an inlet water pressure of 25-45 psig. The inlet water is supplied from the Pulsar booster pump. Pulsar Precision 30: The system will operate with an inlet water pressure of 5 psi.
   g. The briquette tank must have a capacity of:
      1) Pulsar Precision 30: Thirty (30) pounds of Pulsar Plus Dry Chlorinator Briquettes
      2) Pulsar Precision: Seventy (70) pounds of Pulsar Plus Dry Chlorinator Briquettes
      3) Pulsar Precision (Duo): One hundred forty (140) pounds Pulsar Plus Dry Chlorinator Briquettes
   h. The chlorine output must be controlled by the chemical controller. The timer has eight settings and will be controlled by PCB/HMI.
      1) Pulsar Precision 30: The timer will allow a minimum available chlorine (AvCl) output of 2 lbs/day and 2.5 lbs/day for spas and will allow a maximum available chlorine (AvCl) output of 36 lbs/day and 42 lbs/day for spas.
      2) Pulsar Precision: The timer will allow a minimum available chlorine (AvCl) output of 3 lbs/day and will allow a maximum available chlorine (AvCl) output of 165 lbs/day and 141 lbs/day for spas.

3) Pulsar Precision (Duo): The timer will allow a minimum available chlorine (AvCl) output of 6 lbs/day and will allow a maximum available chlorine (AvCl) output of 330 lbs/day and 282 lbs/day for spas.

i. The sanitization system must be capable of functioning in temperatures between 40° F. and 95° F.

j. The sanitization system must operate with Pulsar Plus Dry Chlorinator Briquettes having 65% minimum available chlorine with a 0.4 to 0.6% scale inhibitor (by weight).

k. The system must incorporate a dustless loading feature to capture the dust from the briquettes while replenishing the hopper contents.

l. The sanitization system must be installed per manufacturer's recommendations.

B. pH Buffering System (Muriatic Acid)

1. Chemical feeders for muriatic acid must be peristaltic type pumps. Chemical feed pump(s) must be provided and connected to the filtered water return lines to the pool(s) as shown on the pool plans. The pump(s) must be capable of feeding a solution to the pool(s) to maintain pH level against the back pressure involved and must be fully adjustable while in operation.
2. Chemical feeders must be manufactured by LMI, ProMinent, G. H. Stenner & Co., or approved equal.
3. The pump(s) must be provided complete with fractional horsepower motor for 120V 60 Hz current, plastic feed lines, and fitting necessary for connections to pool system piping.
4. The chemical pump(s) must be electrically connected to and operated by the water chemistry controllers.
5. The acid pump(s) must be affixed with a metallic stamped label indicating the chemical being pumped and the pool to which it is connected.
6. Provide non-metallic wall mounted shelf support for the chemical feeder(s).
7. Acid Drum/Carboys
   a. Provide four (4) fifteen (15) gallon acid drums.
   b. Provide two (2) two drum modular spill platform. Platform must be molded high-density polyethylene with removable polyethylene grating. Platform must be 26.25" x 51.5" x 6.5" with a spill capacity of 30 gallons and a load capacity of 5,000 pounds. Platform must be an Eagle two drum modular spill platform model #1632 or approved equal.
   c. Provide one (1) low profile ramp. The ramp must be molded with high-density polyethylene. The ramp must be an Eagle low profile ramp model #1689 or approved equal.
8. Provide "Vapor Shield" vent check valve for the acid drum/tank which seals container while allowing the liquid to remove via pump. The Vapor-Shield must prevent an internal vacuum and collapse of a sealed container and must also prevent the pump from developing a vacuum-lock while attempting to remove the liquid from the sealed container. The Vapor-Shield must prevent the release of acid vapors. The Vapor-Shield body must be constructed entirely from schedule 80 PVC with 3/8" polypropylene tube fittings and factory-installed acid resistant viton sealant on threaded connections. The diaphragm and O-rings must be constructed of acid resistant viton. Metallic or materials not rated appropriate for use with acid should not be used. The Vapor-Shield must be fitted with a ¾" male NPT threaded fitting to allow for the installation onto common five (5) through fifty-two (52) gallon acid shipping container caps and lids. The unit must be supplied with no less than fifteen (15) feet of 3/8" polyethylene tubing. Vapor Shield must be Recreonics #52-095 or approved

equal. An Acid Fume Scrubber, part #7747090, with refill reagent kit, #7747091, manufactured by ProMinent is an equal.

C. Ultraviolet Dechloramination and Disinfection System
1. Medium Pressure UV
a. Ultraviolet Disinfection Equipment: Must operate within the UVC electromagnetic spectrum emitting wavelengths in the range of 200nm to 400nm. This required wavelength will provide constant disinfection/inactivation of bacteria, algae, molds, viruses, and destruction of Monochloramines, Trichloramines, and Dichloramines. Ultraviolet Lamp/Chamber and Spectra Touch Control Panel by Evoqua Technologies Ltd. or approved equal. Deviations/exceptions must be provided in writing to and approved by the designer prior to the bid date.
1) Ultraviolet disinfection equipment by Aquionics and Prominent are approved equals.
b. The UV System must have a MET or equivalent (ETL, CSA, or UL) listing, be NSF-50 2016 certified including Section 14.18 (crypto inactivation) and 3rd party validated to the USEPA UVDGM 2006 Guidelines.
1) Equipment General Description: The Ultraviolet System must be provided in a complete package to include a stainless-steel chamber, Spectra Control System located in NEMA 12 (IP52) rated panel, Medium Pressure Bulb(s) designed to emit wavelengths within the UVC electromagnetic spectrum, automatic wiper system, and Project Commissioning by a Certified Ultraviolet Technician.
c. Wafer (WF) Units: Ultraviolet manufacturer to offer unit capability of a horizontal OR vertical installation application using state of art design and direct flow through characteristics. Unit must be a medium pressure system with 94% UVT at the indicated design flow rate. Systems validated or designed for flows based on 98% UVT are not acceptable. Chamber and Control Cabinet must be as indicated on the drawings.
d. Ultraviolet Lamp
1) Ultraviolet lamp must be medium pressure high intensity. Lamp must be designed to emit continuous Ultraviolet wavelengths in the range of 200nm to 400nm. This will provide optimal disinfection benefits and destruction of the Monochloramine, Dichloramine, and Trichloramine compounds. The lamp(s) must remain unaffected by temperature variance of 0 degrees F (-17 C) to 200 degrees Fahrenheit (93 degrees Celsius).
2) The lamp system must provide a constant dose of not less than 60 mJ/cm2 until the end of the lamp life for indoor applications and not less than 40 mJ/cm2 for outdoor disinfection and this must be based on constantly monitoring the full recirculating flow rate, not on a side stream treatment. The system must be equipped with infinitely variable power control of the lamp intensity & dose. Power stepping not acceptable. The lamps must be capable of turndown to 30% of the nominal rated power.
3) The lamp must be connected via means of a plug connector and must have a mechanical interlock to prevent lamp removal when lit for safety reasons.
e. Ultraviolet Reactor
1) The unit must be constructed of 316L stainless-steel electropolished and passivated to prevent corrosion within the harsh pool environment.
2) The Ultraviolet chamber must come complete with the following equipment: Ultraviolet intensity monitor factory calibrated to provide

intensity in mWcm2, monitors providing percentage of lamp output not acceptable. It must include a built-in alarm system to notify the operator when the output level drops below the required level of 60 mJ/cm2 for indoor pools or 40mJ/cm2 for outdoor pools (or operator set dosing levels).

3) UV Reactor will be a validated system with third party testing to a recognized international standard such as the USEPA DGM.
4) Ultraviolet temperature monitoring system must be provided to maintain system integrity in the event of flow interruptions to the chamber.
5) Ultraviolet chamber must come complete with annealed quartz sleeve with “O” ring seals for water tightness. The system must be complete with advanced seal arrangement to reduce the risk of quartz over-compression on the seal face.

f. Automatic Wiper System
1) An automatic cleaning system must be provided for cleaning of quartz sleeve and Ultraviolet monitor probe. The system must travel the entire length of the quartz sleeve twice per desired cleaning cycle. Precision molded wiper rings must be provided to ensure thorough quartz tube cleaning and quartz tube protection. The wiper cycle must be user selectable and adjustable within a range of 5 minutes to 24 hours depending on anticipated application and deposit build-up.
2) The wiper system must have the following characteristics:
a) The system must utilize direct drive with square faced coupling and acme threaded shaft to prevent slippage and pin shearing. Systems utilizing shear pins or complicated gear boxes will be unacceptable.
b) The wiper power supply must be 24-volt DC for improved safety. Higher voltage not acceptable.
c) System must incorporate Direct Shaft Encoding for positional location. Systems relying on external limit switches or internally located magnets will be unacceptable.
d) The wiper interval must be operator selectable with optional override switch.
e) Wiper faults must be indicated on the control system display.
f) Wiper System to utilize “Intelligent Operation” for automatic start-up commissioning.
3) Records wiper position at chamber ends. Position must be fixed and not dependent on a timed interval or component striking end of chamber.
4) Establish a travel run without using limit switches to ensure system integrity and longevity.

g. UV Strainer
1) The UV system must be provided with a downstream strainer to protect against the possibility of lamp/quartz breakage traveling downstream.
2) Pressure gauges must be provided on each side of the strainer. Gauges must be liquid filled, 316L stainless-steel bourdon tube type with a minimum 2-1/2-inch diameter dial, high impact polypropylene or stainless-steel case, corrosion resistant white scale with black divisions and numerals, 300 Series stainless-steel heavy duty rotary bushed movement, black enameled balanced Micrometer pointer. Pressure ranges must be calibrated in psig (0-60 psi). Basis of Design: Gauges must be manufactured by Weksler Instrument Corporation or approved equal.

3) A stainless-steel filter type pressure snubber must be provided for each pressure gauge consisting of a 3/8-inch diameter by 1/8-inch-thick micro metallic stainless-steel filter and placed in the line just before the pressure gauge. Provide isolation brass valves or brass gauge cocks at each gauge for easy replacement and maintenance.

h. Ultraviolet Control System
   1) The control cabinet must be a SPECTRA control unit and or pre-approved equal.
   2) The power must be controllable to provide full power, half power and infinite variable power based on real time interface with changes in UVT, Flow Rate or Combined Chloramines. The power panel must house the electronic ballasts required to ignite and power the lamps.
   3) Three levels of operation must be provided to meet the needs of the operator and pool environment: Simple Control (start, stop and reset), Full Parameter Display, and Customized Operator Configuration.
   4) Modes of operation must be password protected to secure system critical setup functions. Touch Control system must have clearly identifiable start, stop, and reset icons (suitable for gloved operation) with Running and Fault LCD indicators.
   5) The display must include the following:
      a) Ultraviolet calculated dose
      b) Ultraviolet intensity (as a percentage and mW/cm2)
      c) Lamp Current
      d) Flow rate (as gallons per minute or m3/hour)
      e) Chamber Temperature
      f) Operation hour meter
      g) Fault indicators to include Lamp fault, low UV & temperature alarm, ground fault trip, wiper fault.
      h) Alarm functions must have a simple text message display to assist in fault finding.

i. Ultraviolet Control System Interface
   1) The Control system must have a minimum of the following system interface control:
      a) Remote operation
      b) Process interrupt features (from valves & flow meters)
      c) Low UV dose
      d) Flow meter input.
      e) Auto-Restrike.
      f) Half to full power UV setting with 24 hour/7-day settable timer.
      g) Variable power/Dose pacing interface
   2) Control system must have built in data-logging capabilities to record the following information:
      a) UV intensity required.
      b) UV intensity measured.
      c) Lamp current
      d) Chamber Temperature
      e) Flow Rate
      f) Time and date stamp, every alarm generated.

j. Manufacturers must maintain spare or replacement parts in the USA for the same day or not longer than next day delivery in North America.

D. Electronic Flocculation System

1. The Clear-Flow Electronic Flocculation system must be provided and installed on the recirculation piping for the swimming pool(s) and spa(s). The Clear-Flow system must be a non-chemical water treatment system designed to operate as an electronic flocculant in recreational water systems. When implemented into the system, the Clear-Flow system must work to agglomerate both organic and mineral particulate resulting in filtration enhancement on all types of filtration systems. This filtration enhancement must allow for a reduction in backwashing frequency - saving water, chemicals, and energy.
2. The Clear-Flow system must be UL listed and certified to NSF/ANSI Standard 50 and documentation of such certification must be provided by the manufacturer with each system.
3. When used in a recreational water application, the Clear-Flow system must work as an electronic flocculant. By generating and propagating a low-frequency treatment signal throughout the entire plumbing system, the technology must produce an ongoing flocculation effect which will aid in a reduction in turbidity and improved clarity.
4. The Clear-Flow system's ongoing flocculation effect must enhance filtration efficiency. The flocculation effect must create larger particles allowing for a reduction in both frequency and duration of backwashing.
5. Equipment
    a. The following components are contained in a standard Clear-Flow kit and must be provided for each system:
        1) ABS or SS enclosure with 3 glands (2 for signal leads and 1 for power supply)
        2) Signal cables complete with mounting tags (Temp. rating -40°F to +140°F) (Qty. 2)
        3) Stainless steel hose clamps (Qty. 4)
        4) Gland plug (Qty. 1)
        5) 2A / 250 VAC UL-listed slow blow fuse (Qty. 1)
        6) 4mm Allen wrench (for grub screw) (Qty. 1)
6. Clear-Flow electronic flocculation system models must be the following:
    a. For pipes up to 3": Model # CF-300C
    b. For 4" pipes: Model # CF-400
    c. For 6" pipes: Model # CF-600
    d. For 8" pipes: Model # CF-800
    e. For 10" pipes: Model # CF-1000
    f. For 12 pipes: Model # CF-1200
7. Power Requirements:
    a. Input Voltage: 100–240 VAC
    b. Input Frequency: 50 - 60 Hz
    c. Power Rating: 4W for CF-300C, 5.4W for all other models
    d. Internal Fuse Rating: 2A / 250VAC UL-Listed slow-blow
    e. Temperature Range: -40°F to +140°F
    f. The electrical supply must be properly grounded, or the system will not work. Hard wiring is preferred to avoid accidentally unplugging the unit.
    g. All safety-critical components must conform to relevant CE/IEC/UL 60950. E235235. Terminals, wires, fuse, on/off switch, AC/DC PSU. PSU must be Class II protected.
    h. Armored 2 Core Cable:
        1) Spec. BC 6883; 1999
        2) IEC 600332 –3—22 Category A
        3) Temperature rating - 22°F to +140°F
        4) ISO 9001 – 2008 Approved
8. Installation

a. To ensure proper start-up of equipment the Contractor must consult a Clear-Flow representative.
b. Optimal results are achieved if the Clear-Flow system is connected to a grounded power outlet (100-240 VAC, 50-60 Hz, 4-amp) that shares the same ground as the recirculation system the unit is being installed on.
c. The Clear-Flow system must come with two identical signal cables. One is intended as the “T” (transmit) signal connection, the other is intended as the “A” (antenna) signal connection. The “T” signal tag must be installed downstream from the pump and before the filter. It is preferred that the “T” signal tag is mounted on a metal reducer or stainless-steel spool piece downstream of the pump. The “A” tag must be mounted on a metal structure that is electrically connected to the system loop, which may include but is not limited to a grounded filter, nearby structure, or ground rod.
d. The Contractor must provide a stainless-steel spool piece matching the main recirculation header pipe size installed between flanges downstream of the recirculation pump(s) and upstream of the filters to facilitate installation of the “T” signal tag per manufacturer requirements. Coating must be 3M Scotchkote 134 fusion bonded epoxy, or approved equivalent on the complete interior of fitting.
e. The maximum cable run length from the control cabinet (typically wall mounted) to the “T” signal tag installed on the pool recirculation pipe must be 33 feet. Installation locations must be coordinated to meet this parameter.

9. The Clear-Flow system unit must be rated for -40º F + 140º F ambient operation. The unit must have no ventilation requirements and be able to be used indoors and outdoors.
10. After identifying the proper installation location for the “T” tag, the Contractor must prepare the point for strong electrical contact with the tag. The Contractor must remove any epoxy or enamel coating which may inhibit a strong connection. The Contractor to make output connections per wiring schematic. Connect “T” and “A” connections into the labeled terminals inside the enclosure.
11. The Contractor must confirm Clear-Flow system is functioning properly and operating under the following conditions. After powering on the unit, consult the LCD screen to determine the frequency and amperage output.
    a. The optimal frequency range is between 100-350 kHz.
    b. Optimal amperage is between 1 and 5 amps.
    c. If frequency and amperage are outside of these ranges, the Contractor must adjust capacitor switches on the upper right side inside the enclosure.
    d. If current amperage is not achievable under 5 amps after making capacitor adjustments, the Contractor must disconnect “A” tag from inside the terminal block and repeat adjustment of capacitors.
    e. If these steps do not result in an optimal sine wave within the recommended frequency and amperage, the Contractor must consult a Clear-Flow Representative.
    f. As an additional means of signal verification, an oscilloscope can be used. By touching the oscilloscope probe onto the pipe near where the “T” tag is connected, signal strength and frequency can be measured. A clean, declining sine wave with minimal harmonics should be observed.
12. The Contractor must cut excess signal cable, but not to less than 10 feet (3 meters) in length. The Contractor must not coil power cord or signal cables; doing so will interfere with signal operation.
13. The Clear-Flow system must be powered on/off via a switch on the enclosure.
14. Replacement fuses must be UL-listed.

15. The complete installation must be by the manufacturer's installation instructions and certified on-site for proper operation by the manufacturer's representative for each system installation.
16. The Clear-Flow system requires that the electrical supply be properly grounded. The Contractor must follow Institute of Electrical and Electronics Engineers (IEEE) standards ensuring a ground resistance of 5 ohms or less.

2.7 WATER CHEMISTRY MONITORING AND CONTROL SYSTEMS

A. A programmable pool chemical automation system must be provided for continuous monitoring and control of the pool(s) water chemistry and related disinfection equipment. The installation of the system must be per the manufacturer's specification. A factory trained/authorized representative must provide training to the Owner and the training must be video recorded. Water chemistry controllers must be provided by ProMinent Fluid Controls, BECS Technology, SB Control Systems, or a technically equal system capable of providing equal performance for operating functions.
   1. The water chemistry control systems for the pool(s) and spa must feature and be capable of the following. Water chemistry controllers without these capabilities and features are not considered equal. Water chemistry control system requirements are based upon the following products: ProMinent DCM511/512, BECSys7, Chemtrol 3000.
      a. Continuous, real-time monitoring and control of pH and ORP.
      b. Free chlorine, total chlorine, combined chlorine in PPM, system flow rate, water chemistry balance calculations, water temperature, and other readings and control as deemed necessary for the project per this section.
      c. The controller must have the ability to monitor and control the UV treatment system.
      d. The controller must manage the recirculation pump with a programmable Fireman Cycle feature, which automatically turns off the Heater, UV, and Auxiliary systems prior to shutting off the recirculation pump.
      e. Management of the recirculation pump on/off status.
      f. Management of the heater on/off status based on real-time water temperature reading.
      g. Management of the water level in the pool or surge tank and must provide programming to lock out chemical feed during potable water fill events.
      h. The utilization of simultaneous ORP and PPM (bracketing) control for managing both the quantity and quality of the sanitizer/oxidizer. Controllers that do not have the ability to control simultaneously to ORP and PPM control points or that utilize an alternate chlorine set point or boost function will not be considered equal.
      i. Actuating outputs in the following operator selectable modes: off, manual, automatic, proportional and must have a manual on fail-safe timer to ensure that if the controller is left in manual mode, the controller will revert back to automatic mode to prevent an over-feed event.
      j. Programmable events can be time set to occur daily, weekly, or monthly.
      k. Remote monitoring of the recirculation flow rate of the system when installed with compatible magmeters.
      l. Provide use of flow signal as a supplemental chemical feed interlock to prevent the dosing of chemicals during a system low flow/no flow condition.
      m. The controller must continuously monitor data-log while being monitored and control via two-way remote communication.

n. The controller must continuously calculate and display the Langelier Saturation Index and Ryznar Index using either sensor data and/or manual input for pH, temperature, total alkalinity, and calcium hardness.
o. Programmable high and low alarm levels for control functions with operator-selectable feed lockout and alarm buzzer options.
p. Performance and Certifications
    1) The controller system must be NSF/ANSI 50 listed for automatic controller equipment for swimming pools, spas, and other recreational water facilities.
    2) The controller system must be certified to UL61010/IEC61010 standards.
    3) The controller must automatically activate the appropriate chemical feeders in order to maintain the sanitizer/oxidizer level:
        a) Within +/- 0.1 parts per million (PPM) or +/- 10 mV (millivolts) of oxidation reduction potential (ORP)
        b) The pH within +/- 0.1 pH unit of the set points selected by the operator.
        c) Set point and calibration levels must be adjustable with a keypad mounted on the front panel of the unit as well as the remote interface.
        d) The controller must use pH sensor with +/- 0.04 accuracy in the operational range of 6.8 – 8.2 as certified by NSF.
        e) An ORP sensor with an accuracy of +/- 3% mV as certified by NSF.
        f) A free chlorine and total chlorine sensor that operates in a range of 0.1 parts per million (PPM) up to 10.0 parts per million (PPM) within a 9% accuracy as tested by NSF or another third-party certifying agency.
q. System Supply
    1) The controller must be factory supplied with:
        a) ORP, pH, temperature, and free chlorine and total chlorine sensors.
        b) A relay capable of being named and programmed for controlling a UV system dosing based on a real-time combined chlorine as calculated by the readings from an amperometric free chlorine and total chlorine sensor.
        c) A flowrate sensor to measure system flowrate.
r. Hardware
    1) The controller must have:
        a) A minimum of seven (7) fully configurable digital inputs.
        b) A minimum of four (4) fully assignable digital outputs.
        c) A minimum of nine (9) configurable analog inputs.
        d) A minimum of five (5), 115 VAC fully assignable relays.
        e) The controller must be capable of expanded capabilities with an optional input/output expansion card kit.
        f) High voltage field wiring must be through a separate NEMA 4X factory engineered and supplied enclosure that precludes direct access to controller electronics. High voltage connections must be clearly identified, and a field wiring diagram must be provided with the controller for the Contractor’s reference. Controller high-voltage relay assignment parameters must be programmed at the factory prior to delivery to installation location.
        g) The controller must include a sensing flow cell that is hydraulically designed to allow verified correct flow and consistent pressure

across sensors. Flow cell will be clear PVC that is modular in concept and have the flexibility to add supplementary water chemistry sensors as desired. The sensing flow cell must include a safety flow switch sensor, water spigot, and isolation valves.

s. Communications
   1) The controller must have as a standard feature:
      a) The controller must include the capability of ethernet connection and secondary wireless communication.
      b) The controller must allow full two-way remote communication and full control of parameters.
      c) Accessibility with a standard internet browser using a fully interactive Ethernet TCP/IP graphical interface that includes security access codes.
      d) Real-time monitor/control with real-time auto polling, data logging, email and text alarms and providing both graphical and report formats via a personal computer, smartphone, or tablet device.
      e) The controller must have the ability to facilitate email or text alarm notifications, historical graphing, and real-time control via a personal computer, smartphone, or tablet device.
      f) The controller must have the ability to export a .csv file once per day with reading type, time, and reading. The export must be done via email and must include the controller serial number. Export data must include ORP, Free Available Chlorine, Total Chlorine, Combined Chlorine, pH, and Temperature.
      g) The controller must have the ability to allow software upgrades and programming as needed in the field.

t. Commissioning and Manuals
   1) The control system must be provided with on-site start-up operator training performed by a representative trained and authorized by the controller manufacturer.
   2) The manufacturer must supply an operation and maintenance manual describing features, operating instructions, maintenance procedures and replacement parts.
   3) Installation of the system must be per the manufacturer's specification and no exceptions must be allowed. A factory trained/authorized representative must provide training to the owner and the training must be video recorded.

2.8 FLOW METERS

A. Recirculation flow meter must be provided according to the manufacturer in the filtered water return lines for the pool(s) as indicated on the drawings. The flow sensor must be the GF Signet 2551 insertion magmeter. Provide the coaxial cable from the sensor to the display/transmitter. Flow meter accuracy must be +/- 2% of reading.

B. Impact flow meter must be provided as indicated on the drawings. Impact flow meter must be a pilot, impact ball, variable area type with one piece, impact resistant machined acrylic plastic body. GPM scale must be permanently etched or imprinted on the meter. Flow rate indicator must be of stainless-steel material. The scale range must be appropriate for a specific flow rate. Pipe size to accommodate backwash rate. The backwash piping flow meter must be BLUE-WHITE series F-300 or approved equal.

2.9 WATER LEVEL CONTROLLERS

A. In Surge Tank Water Level Controller – Lap Pool and Wellness Pool

1. Provide a water level sensing and control system for the pool(s) that will monitor the water level in the surge tank and automatically activate the auto water make-up control valve. For sensing water level and activating make-up water control valve for the pool(s), use Series ELC-810 controller housed in a watertight NEMA 4X UL94 5V UL flammability rated polycarbonate enclosure to meet IP66 and NEMA 4, 4X, 12 and 13 ratings. The controller must utilize two sensors to control water level. ELC-810 series must have a menu-driven LCD display screen and utilize a five-switch user interface for navigation through the menu. The menu must allow changing the following settings: delay to shutoff, alternate sensor option, maximum time on, manual override, delay to normal, type of sensor, high level option, flow sensor active, and sounder with alarm. Menu settings must be capable of password protection. The controller must be capable of displaying the following data: last fill time, last drain time, last alarm. The controller must be capable of determining the following: maximum time on exceeded, over current to solenoid valve, no valve/valve wiring problem, and sensor not working properly. The controller must have a low voltage interlock with auto water make-up solenoid valve and the high-level shutoff solenoid valve and must provide adjustable time delay for increasing level and manual override. The controller must require 115 VAC, 1 phase, 60 Hz power. The water level control package must be manufactured by AquatiControl Technology, model ELC-810-DS-ST-XXX (Coordinate the specific length(s) of cable required for each controller prior to ordering). Refer to drawings for additional information.
2. Provide two proximity switch sensor(s) that must be sensitive to within +/- 1/8” (4mm) of nominal water level. Supply voltage to sensor must be 12V to 24V DC from controller. Current consumption must be < or = 15mA. Response frequency must be 100Hz. Maximum control output must be 200mA. The sensor operating temperature must be -25 Deg. C to 70 Deg. C. Operating humidity must range from 0% RH to 95% RH. The sensor(s) must be mounted in a 1” Schedule 80 PVC pipe (length must be determined by depth of surge tank). Sensing pipe must be mounted to surge tank wall with composite/non-metallic hangers and stainless-steel hardware. Sensing pipe(s) must be capable of being submerged under water safely. Refer to drawings for additional information.
3. Wiring from the sensor to the controller must be provided and must be connected to the terminal points mounted within a corrosion resistant, nonmetallic NEMA 4X enclosure. Wiring connections must be made through the bottom of the enclosure. The enclosure size must be no less than 8” wide x 5” high x 4” deep. The access door must be the entire front face panel of the enclosure. Confirm location in field.
4. Major components must be plugged-in using WAGO terminal blocks for ease of installation and replacement. Unit must be designed to activate a 24-volt AC solenoid valve.
5. Discharge of make-up water must be into a fill funnel and piping to the pool(s). Refer to the drawings for additional information.

B. In Mechanical Room – Wet Well Water Level Controller - Spa

1. Provide a water level sensing and control system for the spa that will monitor the water level in a well located in the mechanical room and which will automatically activate the auto water make-up control valve. For sensing water level and activating make-up water control valve for the spa, use Series ELC-810 controller housed in a watertight NEMA 4X UL94 5V UL flammability rated polycarbonate enclosure to meet IP66 and NEMA 4, 4X, 12 and 13 ratings. The controller must utilize two sensor(s) to control water level. ELC-810 series must have a menu-driven LCD display screen and utilize a five-switch user interface for navigation through the menu. The menu must allow changing the following settings: delay to shutoff, alternate sensor option, maximum time on, manual override,

delay to normal, type of sensor, high level option, flow sensor active, and sounder with alarm. All menu settings must be capable of password protection. The controller must be capable of displaying the following data: last fill time, last drain time, last alarm. The controller must be capable of determining the following: maximum time on exceeded, over current to solenoid valve, no valve/valve wiring problem, and sensor not working properly. The controller must interlock with auto water make-up solenoid valve and must provide adjustable time delay for increasing level and manual override. The controller must require 115 VAC, 1 phase, 60 Hz. The water level control package must be manufactured by AquatiControl Technology, model ELC-810- DS-WW-XXX (Coordinate the specific length(s), "XXX," of cable required for each controller prior to ordering). Refer to drawings for additional information.

2. Provide a proximity switch sensor that must be sensitive to within +/- 1/8" (4mm) of nominal water level. Supply voltage to sensor must be 12V to 24V DC from controller. Current consumption must be < or = 15mA. Response frequency must be 100Hz. Maximum control output must be 200mA. The sensor operating temperature must be -25 Deg. C to 70 Deg. C. Operating humidity must range from 0% RH to 95% RH. The sensor must be mounted in a 1" Schedule 80 PVC pipe 3 feet in length – the sensing pipe to then be mounted into a static line from the pool. The sensing pipe must be mounted into the static line via an adjustable collar that allows for quick level adjustments. Refer to drawings for additional information.
3. Wiring from the sensor to the controller must be provided and must be connected to the terminal points mounted within a corrosion resistant, nonmetallic NEMA 4X enclosure. Wiring connections must be made through the bottom of the enclosure. The enclosure size must be no less than 8" wide x 5" high x 4" deep. The access door must be the entire front face panel of the enclosure. Confirm location of controller in field.
4. Major components must be plugged in using WAGO terminal blocks for ease of installation and replacement. Unit must be designed to activate a 24-volt AC solenoid valve.
5. Discharge of make-up water must be into a fill funnel and piping to the spa. Refer to the drawings for additional information.

C. Solenoid Valves

1. Provide a make-up water solenoid valve, normally closed, stainless-steel fitted, bronze body, 24 VAC slow-closing type. Interlock with automatic water level control system. Refer to the drawings for additional information including size of pipe. Solenoid must be by ASCO 8221 or approved equal.
2. Provide a solenoid valve for the high-level sensor, normally opened, stainless-steel fitted, bronze body, 24 VAC slow closing type. Refer to Plumbing drawings for pipe size. Interlock with automatic water level control system. Refer to the drawings for additional information. Solenoid must be the 8221 Series by ASCO or approved equal. Maximum size of 2 1/2".
3. Provide a solenoid valve for the high-level sensor, normally opened, stainless-steel fitted, stainless steel body, 24 VAC slow closing type. Refer to Plumbing drawings for pipe size. Interlock with automatic water level control system. Refer to the drawings for additional information. Solenoid must be the 2DSO400-2000 Series by STC VALVE or approved equal. Sizes range from 3" to 6".

2.10 DECK EQUIPMENT, INSERTS & ANCHOR SOCKETS

A. The following items must be supplied unless otherwise noted. Proprietary names are to designate performance only. Equal products will be accepted.

1. Grab rails must be provided as required in the quantities and to the dimensions as shown on the drawings. Grab rails must be fabricated of one continuous length of polished and buffed tubing. The tubing must be ASTM-A-554 grade 316L stainless-steel, 1.50-inch OD x 0.120-inch minimum wall thickness, polished and buffed to 320 grit finish and must be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance. Bends must be smooth and free of wrinkles. Grab rails must be pretzel bend style with dimensions as indicated in the plans and as manufactured by Spectrum Products, SR Smith, Paragon or approved equal. Anchor sockets for grab rails must be of the wedge type, cast bronze or stainless-steel, 4 inches in depth and made to receive 1.50-inch OD tubing as manufactured by Paragon #28105, SR Smith #AS-200B, Spectrum #54052 or approved equal. The wedge must be cast bronze, incorporate a stainless-steel tightening bolt, and flat washer, and be designed as the sacrificial element to the anchor system. Metallic components must be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance. Anchors must be provided with flush closure caps and escutcheons with set screws where indicated. Escutcheons must be of the keyhole or oblong shape, similar to the casted, electro-polished stainless-steel escutcheon with set screw by Paragon #28303SS, SR Smith #IEP-200, Spectrum #35222 or approved equal.
2. Entry rails must be provided as shown on the drawings, fabricated from one continuous piece of polished and buffed ASTM-A-554 grade 316L stainless-steel, 1.50-inch OD x 0.120-inch wall thickness, polished and buffed to 320 grit finish and must be passivated for maximum corrosion resistance. Bends must be smooth and wrinkle free. Custom rails as manufactured by Spectrum Products, Paragon, SR Smith or approved equal. Custom rail submittal drawings must be complete with details of custom fabrication and installation information. Anchor sockets for railings must be of the wedge type, cast bronze or stainless-steel, 4 inches in depth and made to receive 1.50-inch OD tubing as manufactured by Paragon #28105, SR Smith #AS-200B, Spectrum #54052 or approved equal. The wedge must be cast bronze, incorporate a stainless-steel tightening bolt, and flat washer, and be designed as the sacrificial element to the anchor system. Metallic components must be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance. Anchors must be provided with flush closure caps and escutcheons with set screws where indicated. Escutcheons must be of the keyhole or oblong shape, similar to the casted, electro-polished stainless-steel escutcheon with set screw by Paragon #28303SS, SR Smith #IEP-200, Spectrum #35222 or approved equal.
3. Spa transfer railing must be provided as shown on the drawings, fabricated from one continuous piece of polished and buffed ASTM-A-554 grade 316L stainless-steel, 1.50-inch OD x 0.120-inch wall thickness, polished and buffed to 320 grit finish and must be passivated for maximum corrosion resistance. Bends must be smooth and wrinkle free. Custom rails as manufactured by Spectrum Products, Paragon, SR Smith or approved equal. Custom rail submittal drawings must be complete with details of custom fabrication and installation information. Anchor sockets for railings must be fabricated from advanced glass reinforced copolymer, 6 inches in depth and made to receive 1.50-inch OD tubing. The anchor body must incorporate four (4) copolymer anti-rotation fins. The fins must be located on the anchor body and will prevent the anchor from spinning in the concrete. The fin must be an integral part of the anchor body. Compression anchors must be manufactured by Spectrum #42696 or approved equal from Paragon or SR Smith. Anchors must be provided with flush closure caps and escutcheons with set screws where indicated. Escutcheons must be of circular, similar to the casted, electro-polished stainless-steel escutcheon with set screw by Paragon #28303, SR Smith #EP-150, Spectrum #24095 or approved equal.

4. Stanchion posts (backstroke) must be provided as required and in the quantities shown on the drawings. The posts must be a straight length of type 316L stainless-steel tubing, 1.90-inch OD x 0.145-inch wall thickness x 8-foot overall length, polished and buffed to 320 grit finish. Stanchions must be capped at one end with a closure plug containing a U-shaped hook and fitted with a stainless-steel eyebolt attached to an adjustable nickel-plated bronze sliding collar. Stanchion with sliding collar and eyebolt as manufactured by Paragon #38106 with #38301, SR Smith #10168-MG with #35-102, Spectrum Products #23614 with #23625 or approved equal. Anchor sockets for stanchions must be of cast bronze or stainless-steel, sized to receive a full 6 inches penetration of 1.90-inch OD tubing as manufactured by Paragon #38201TC, Spectrum Products #23626, Kiefer #700103, SR Smith #AS-100D or approved equal. Each anchor socket must be provided with a flush threaded, vandal proof closure cap Paragon #38201TC, Spectrum Products #23628, or Kiefer #700103C and a grounding lug with screw. Provide Paragon #38303, Spectrum Products #23630, Kiefer #700103K or approved equal spanner wrenches for removing the closure cap. Anchors or sockets must be provided with flush closure caps and escutcheons with set screws where indicated.
5. Starting Blocks
    a. Single post starting blocks (7 required, 6 plus 1 spare) must be provided as indicated on the drawings. Starting blocks must have number plates on both sides numbered 1 through 6. Spare block must not be numbered. Starting block height must be 29-1/2” inch above water level. The starting block top (24” wide x 32” deep) and intermediate sidestep (8” x 12”) must be constructed of UV inhibited high density polypropylene. Confirm step is on correct side (right or left) according to plans. The surface must have a non-skid dual cross-grooved sand textured finish. The top must be permanently positioned at a 10° tilt towards the pool. Frames must be 2.5 square inch x 0.125-inch wall thickness 304 stainless-steel tubing with a powder coated finish. Refer to the Owner/Architect for color selections. Verify height of starting block above water before ordering. The backstroke bar must be 1” diameter and allow both horizontal and vertical grab positions. Starting block must be custom blocks as detailed on the plans similar to the Track Start Quickset by Paragon, Legacy by SR Smith, Riptide by Kiefer, Record Breaker by Spectrum Products, or approved equal. Each starting block must have two labels affixed stating "Warning – For Use by Trained Competitive Swimmers Only – Execute Shallow Racing Dives Only - Impact with Pool Bottom Can Cause Permanent Injury."
    b. Anchors sockets for single post starting blocks must be designed to prevent rocking and must be provided with depths that allow for installation of starting blocks at all course layouts indicated on the drawings. A stainless-steel cap must be provided to flush mount on the deck when starting block is removed. The anchor socket must be cast T304 stainless-steel with wedge assembly consisting of a bronze wedge and T304 stainless-steel hardware. Anchors for starting block must be by the starting block manufacturer - Paragon Quickset Dual-wedge anchor, SR Smith Rock Solid anchor, Spectrum Products Record Breaker anchor, or Kiefer Riptide anchor.
    c. Starting block safety covers must be provided for all starting blocks and are designed to keep unwanted users off starting blocks. The cover is made of 1/16” thick tough, lightweight plastic with a UV stabilizer and fits 24” x 32” starting block tops. The conical shape and safety orange color act as a deterrent of stating block use. Each cover is provided with a bungee cord for securing the cover starting block top.
    d. Starting blocks must be manufactured to receive individual timing system speakers for mounting to the starting block. The horn bracket kit must include horn

brackets, left and right slide brackets, and mounting hardware for attaching the timing system speaker and connection plate to the underside of the starting block on site with the provided screws. The horn bracket must be fabricated from T304 stainless-steel and powder-coated clear. Slide brackets must be manufactured of marine-grade HDPE. Mounting hardware must be stainless-steel. Individual timing system speaker mounts must be equivalent to the Speaker Assembly Mount K-SP6/45 with mounting slide kit MK-29 as manufactured by Colorado Time Systems (for Paragon or SR Smith starting blocks), Spectrum Products #1730176, or approved equal.

6. Backstroke start devices (6 required) must be non-slip wedges designed to adapt to starting blocks provided. Backstroke start devices must automatically retract up and out of the water and have a 10-degree angle for secure foot placement at the race start. Backstroke start devices must be the Backstroke Start Device by Colorado Timing, Backstroke Start Device by Spectrum Products, or approved equal. SR Smith #13-603, or Pool Wall Mounting Kit with Strap by SR Smith #13-601.)
7. Lifeguard Chairs
   a. Lifeguard chairs must be constructed of UV inhibited recycled HDPE chairs. Maximum seat height must be 48”/ 66” above the pool deck. Joints must be secured using T- 316L stainless-steel screws. Refer to the Owner/Architect for color selections.
      1) Lifeguard chairs (2 required) must be Spectrum Products Mendota #45023, Tailwind Furniture #LG510, Kiefer Forever Guard Chair #500231, SR Smith Sentry #SLGC42 or approved equal.
      2) Lifeguard chairs (1 required) must be Spectrum Products Mendota #45023, Tailwind Furniture #LG510, Kiefer Forever Guard Chair #500231, SR Smith Sentry #SLGC66, or approved equal.
8. Surge tank access hatch must be provided in quantities as shown on the drawings. The access hatch must be a single door 3’-2” x 2’-6” with 1” fillable pan to receive ceramic tile and grout or concrete fill to match the surrounding deck. The frame must be ¼ inch extruded aluminum with built in neoprene cushion and continuous anchor flange. Door must be ¼” aluminum plate reinforced with aluminum stiffeners as required. The door must be equipped with heavy continuous stainless-steel hinges and must have compression spring operators for easy operation. The door must open to 90 degrees and lock automatically in that position. The door must be built to withstand a live load of 150 lbs. per square foot and equipped with a continuous Type 316L stainless-steel hinge, tubular type, and an automatic hold open arm with release handle. Hardware must be type 316L, 18-8, stainless-steel. A flush lift handle and a snap lock with removable key wrench must be provided. Factory finish must be mill finish with bituminous coating applied to the exterior of the frame. The access door must be Type TER single leaf pan type door ordered as a custom size as manufactured by the Bilco Company.
9. Sleeves for surge tank valve extensions must be Spectrum Products Valve Extension Body with Lid and Key #1910386, or Spectrum Products Bronze Anchor Kit 1.90-inch O.D. x 6-inch-deep Anchor (field modification required) with Lid and Key #23638-00.
10. Surge tank ladder must be provided for the depth of the surge tank as indicated on the drawings and include a pull-up handrail. The ladder and handrail must be constructed of polypropylene that conforms to ASTM-D4101. Ladders must meet all ASTM0C-497 load requirements and OSHA 1910.26 and 1910.27 specifications. The ladder must be fastened to the floor and wall with 1/2” x 3-3/4” 316 stainless-steel anchors and installed per manufacturer’s instructions. Adjustable mounting bracket must be 8”. Aluminum reinforced copolymer polypropylene rail must be 1-3/4” x 1-3/4” diameter. Steel reinforced copolymer polypropylene ladder rungs must be 1-5/8” x 1-1/4” diameter with

molded finger grips, 12” O.C. The ladder must be manufactured by Lane International Corporation or approved equal.

11. Pool Lift
    a. The Lap Pool lift must be a battery powered handicap lift with footrest assembly. Lift must comply with the Americans with Disabilities Act Access Guidelines (ADAAG), be capable of lifting 400 lbs and must include a seat belt assembly. The following accessories must also be provided: caddy, arm rest assembly, lift cover, extra battery, wired controls. Stainless-steel components must be 316L. Lift must be a SR Smith Splash Aquatic Lift Extended Reach #370-0000, Spectrum Products Motion Trek BP 400 #163145, Aqua Creek Products LLC Mighty 400 #F-MTY400 or approved equal. Confirm pool lift fits on pool perimeter and operates correctly.
    b. The Wellness Pool lift must be a battery powered handicap lift with footrest assembly. Lift must comply with the Americans with Disabilities Act Access Guidelines (ADAAG), be capable of lifting 500 lbs, and must include a seat belt assembly. The following accessories must also be provided: caddy, arm rest assembly, lift cover, extra battery, wired controls, stability vest, and spineboard attachment. Stainless-steel components must be 316L. Lift must be the Spectrum Products Traveler BP 500 #27610, Aqua Creek Products LLC Mighty 600 #F-MTY600 or approved equal. Confirm pool lift fits on pool perimeter and operates correctly.
    c. The anchor for the pool lift must be furnished with the lift. The anchor must be an embedded sleeve made of glass reinforced copolymer, 300 series stainless-steel, or bronze. The depth of the anchor must be 6 inches, and the anchor must include a lug for proper bonding with the pool structure. The anchor must be installed in accordance with manufacturer's instructions, including required or recommended support footings. Manufacturer must provide an anchor cap and key for times when the lift is not in use. Sockets must be provided as stainless-steel or cast bronze for swimming pool accessories.

2.11 LOOSE EQUIPMENT

A. The following items must be supplied unless otherwise noted. Proprietary names are to designate performance only. Equal products will be accepted.

1. Competition floating lane ropes must be as shown on the drawings and described in these specifications. Floating lane ropes must be a non-turbulent type with wave quelling floats and 3/16” stainless-steel coated cable. Floats must be injection-molded polyethylene. Colors to alternate the length of the pool with a contrasting solid color for the final 15 feet. Owner/Architect to select colors from standard color chart. Floating lane ropes must be provided as completely assembled and installed with take up reel, type 304 stainless-steel spring and cable lock, hooks, and wrench. 5/8” wrench must be made of a forged steel shaft with a polished chrome finish. The take up reel must be constructed of type 304 stainless-steel. The spool must be a bronze nickel-plated casting with a nylon sleeve. Floating lane ropes must be similar to Competitor Swim Products, Competitor 4” Racing Lanes, Kiefer Advantage I (4.5”) Racing Lanes, or Anti-Wave ForeRunner (4.75”) Racing Lanes, Malmsten Classic Pro (4”) Racing Lanes pre-assembled and sized to fit the length of the pool. Provide contrasting disks located 15 meters from each end to meet resurfacing requirement. This requirement must be met for each possible course length.

Quantities:
Competition Pool: Provide 6 at 25 yards (5 required, plus 1 spare)

2. The lane line anchor must be constructed of two (2) non-corrosive UV stabilized molded PVC sections. The two (2) sections must consist of a top opening flip-up grate hatch and base unit section that are connected with a 316 stainless-steel pin. The grate on the top opening flip-up grate hatch section must have a raised herringbone design and must be certified to AS 4586-2013 Class C for Wet-Barefoot inclining platform (ramp) test for swimming pool surroundings. The unit must not require bonding per NEC 680.26 (c) and must be certified ANSI/NSF/CAN 50-2020 (Section 22.3). Grate sections must be 0.47" (12mm) wide and an outside depth of 1.0" (25.4mm) with a middle depth of 1.83" (46.6mm) for load strength requirements. The lane line anchor unit must be tested to a load pull test of 1,200 lb. minimum based on a 2500 psi concrete pour. The space between grate bars must not exceed 0.315" (8mm) to comply with ANSI/APSP/ICC-16 2017 (and BS EN 13451) for finger and limb entrapment. The grate surface bars must run parallel to the pool wall and with the gap providing at least 40% open space per foot for unrestricted water flow. The lane line anchor unit must include a lane line extension constructed of a stainless-steel braided strap covered with silicon that is flexible and can be stowed within the unit. Lane line extension must be capable of extending beyond the unit to connect to a lane line S-hook. The lane line anchor unit must be secured in a perimeter concrete gutter system with 316 stainless-steel drop-in anchors and socket head cap screws as provided by the manufacturer. The lane line anchor unit must be 16" x 2" wide as indicated on the drawings. Lane line anchor unit must be DalFLEX-16 as manufactured and supplied by Daldorado LLC.
3. Backstroke flags:
    a. Backstroke flags must be provided for all course layouts shown on the drawings. Backstroke flags must be made of Vinyl material, triangular in shape (12" wide x 17" long), and alternating in color, butted end to end on vinyl covered stainless-steel cable. Submit standard color samples for review and approval by the Owner/Architect. The cable must be attached to a stainless-steel take up reel at one end and a stainless-steel tension spring end-fitting at the other. Equipment must be similar to the following items by Kiefer: backstroke flag (#600808), racing lane cable (#210210), take-up reel (#210218S), and spring end fitting (#210219) or approved equal from Competitor Swim Products. Provide backstroke flags with team/school name on one side and lane identification on the other.
4. Recall rope must be 1/2-inch yellow polypropylene rope complete with weight rings and two quick snap connectors made of chrome-plated brass. The rope must consist of a neco plate constructed of soft aluminum that is crimped and used to connect the two pieces of rope to form the required loops. Recall rope must be Recreonics, model #92-965 or equal with specific length ordered to match span between recall rope stanchion posts as indicated in plans.
5. Lane Rope Storage Reel
    a. Lane rope storage reel must be fabricated from two powder-coated aluminum captain wheels joined together by a 1-3/4-inch aluminum axle. This unit must ride easily on four (4) 5" stainless-steel casters with individual brakes. The reel must have a tow handle for safe movability. The storage reel should be able to hold 525' of 4" lane ropes or 300' of 6" lane ropes. The storage reel must come assembled. The correct number of storage reels must be provided to store lane lines. Lane line storage reel must be Competitor Swim Products Classic Plus Stor Lane Reel #200-510 with Competitor storage reel cover #200-351, Kiefer Racing Lane Storage Reel #210300 with Storage Reel Cover #210301, SR Smith Powder-Coated StoReel #13-61-5003 with StoReel Cover #30-61-0502 or approved equal.
6. The lifeline must be 3/4-inch blue and white polyethylene rope with floats that are 5-inch diameter by 9-inch-long. Floats must be spaced on five-foot centers. Metallic rope hooks

must be stainless-steel. Provide lifeline at five-foot break between shallow and deep water as shown on the drawings. Lifeline must be equal to Recreonics #14-438.BW or Lincoln Aquatics #44-115 safety line rope, Recreonics #14-381, Lincoln Aquatics #44-190 or Competitor Swim #350EZBW locking 5" x 9" floats, and Recreonics #14-456 or Lincoln Aquatics #44-125 rope end hooks.

7. T-wrench for operation of valve extensions must be fabricated of ¾" diameter SCH 40 stainless-steel pipe. The T-wrench must be 4'-0" in length with a 24" long welded "T" handle. The wrench must be fitted with a ¾" square stainless-steel male end, 1" in length, for operation of valve extensions at the surge tank. Two complete T-wrenches must be provided.

2.12 MAINTENANCE EQUIPMENT

A. The following items must be supplied unless otherwise noted. Proprietary names are to designate performance only. Equal products will be accepted.

1. Wall brush (2 required) - Brush backing must be a flexible polyethylene material with five (5) rows of nylon bristles. The pool brush holder must be permanent mold cast aluminum with hydrofoil flap. The holder must have stainless-steel screws to facilitate brush changes. Handle bracket must be quick detachable mount to fit standard 1 ¼ or 1 ½ inch diameter handles. Brush must be Recreonics #10-135, Lincoln Aquatics #31-020, or approved equal.
2. Skimming net (2 required) - Skimmer head must consist of one-piece molded plastic frame with a reinforced, integral handle bracket suitable for quick attachment to a standard 1¼ or 1 ½ inch diameter handle using bolts and wing nut. The standard nylon net must be attached to the frame using the groove and spline method. Net depth must be 16 inches minimum in the center. Skimming net must be manufactured by Recreonics #10-124, Lincoln Aquatics #31-103 or approved equal.
3. Telescopic Poles (2 required) - Cleaning tool handle must be of the telescopic design and fabricated from corrosion resistant, high-quality anodized aluminum. Poles must be fully adjustable, to desired length, with a simple twist of a cycolac threaded locking device. Poles must consist of a 1-inch tube fitted inside a 1¼ inch tube and be adjustable from a range of 8 ft. to 16 ft. Handle must be adjustable from 8 ft. to approximately 16 ft. having a threaded bushing type clamp to lock handle at desired position. Poles must be Recreonics #10-348, Lincoln Aquatics #30-050 or approved equal.
4. Portable Vacuum Poles
   a. Stainless-steel poles (1 required) –Vacuum head attachment poles are to have a heavy-duty 1¼ inch stainless-steel handle with special brass male and female threaded inserts on the ends. Poles must be 8 ft. each, totaling a 24 ft. length for vacuum head attachment. Poles must be Recreonics #10-330 or approved equal.
5. Test Kits
   a. Provide two (2) test kits:
      1) The first test kit must feature liquid reagents, a color comparator, waterproof instructions and treatment charts, chemistry guide and water gram. Test kit to have the ability to test for free and total chlorine (0.5 – 5.0 ppm), bromine (1-10 ppm), pH (7.0 – 8.0), acid and base demand, total alkalinity, calcium hardness and cyanuric acid. The test kit must be Taylor Complete K-2005C test kit or approved equal.
      2) The second test kit must be photometric and utilize either liquid and powder reagents or tablet reagents for stability that will allow accurate measurement of free and total chlorine (0-10 ppm), bromine, pH, alkalinity, calcium hardness, and cyanuric acid. The test kit must have

solid-state digital electronics and built-in filters. The test kit must be direct reading with automatic blank settings, automatic power cut-off, and store a minimum of the last 10 results in nonvolatile memory. Provide LMP106C Pooltest 6 with Hard Carry Case Kit and LMC001 Check Standard by Lumiso, AquaPRO 6 Test Kit manufactured by Orbeco-Hellige Inc and Reference Standard Kit (LP275680) or M-2005 Commercial Calorimeter Kit, in hard carry case, by Taylor Technologies or approved equal.

6. Vacuum Cleaner
   a. Vacuum cleaner (filtered water return to pool) - (1 required) must be complete with a 36-inch dual manifold head with 50 feet of 1-1/2-inch floating hose. Hose must be Recreonics, #10-414, Lincoln Aquatics #29-255 or approved equal. 24 ft. stainless-steel pole must be available for attachment. The portable cartridge vacuum cleaner system must include a 155 square foot T-316 stainless-steel up-flow single cartridge filter, a 1 HP self-priming thermoplastic self-priming pump 1-1/2-inch suction and discharge connection and 110 cubic inch strainer capacity. Cartridge must be Harmsco #ST/155 or approved equal. The system must be provided with one spare cartridge filter. The pump motor is 115-volt single phase, open-drip proof and must be UL and NSF listed. The pump motor must be provided with a 120-volt Hubbell switch, weatherproof switch cover, in-line pre-wired GFCI and a 100’ power cord. The cord must be wired to a 20-amp, 115-volt switch which must be mounted on the pump motor. Interconnecting pipe and fittings must be schedule 40 PVC. The entire assembly must be bolted to a T-316 stainless-steel cart and must have pneumatic wheels with grease fittings and roller bearing hubs. The unit must be Recreonics #10-806, Lincoln Aquatics #27-010 or approved equal. Accessories must include a minimum 1-1/2-inch x 25 ft. discharge hose with stainless-steel hose clamp. Hose must be Recreonics #10-440, Lincoln #29-146 or approved equal.
7. Robotic Pool Cleaner
   a. Provide one (1) dual pump floor, wall, and waterline only automatic commercial robotic pool cleaner. The cleaner must provide up to 5,820 square feet per hour of cleaning coverage as well as filter up to 9,000 gallons per hour. Unit must have 4-, 6- and 8-hour cleaning cycles. The pool cleaner must be provided with 131 feet of cable, PVC brushes, two (2) bottom loaded filter bags and a remote control for “spot cleaning”. Features must include zero-depth entry sensor and transportation caddy. Unit requires a dedicated 120-volt circuit receptacle with GFCI to transform which provides 27 volts the automatic pool cleaner. The automatic pol cleaner must be #9999359-W120 WAVE 120 as manufactured by Maytronics USA or approved equal.
8. Stainless-steel Cleaner - Provide a stainless-steel cleaner. The cleaner must comprise of one (1) gallon of organic passivation solution. It must be complete with instructions for proper maintenance of stainless-steel surfaces and material safety data sheets for the passivation solution. The cleaner must be the Spectra-Clean System 2 as manufactured by Spectrum Products. Product must be applied with 3M scouring pad, or equivalent.
9. Stainless-steel Protective - Provide protective coating on swimming pool rail goods. The coating must provide envelope protection. Surfaces coated must be clean and dry and free of oil, films, grease, silicones polishes and waxes, anything that leaves a film on the surface. Care must be taken not to clean the surface with a type of cleaner or solvent that may leave behind a thin film. The coating must be applied at approximately ½ mil WFT yielding a dry film thickness of 3-5 microns. Three coats are required. Allow to dry to touch between coats. The coating must be ProtectaClear-AF

as manufactured by Everbrite and distributed by TMI Salt Pure Corporation or Spectra Shield as manufactured by Spectrum Products.

2.13 SAFETY EQUIPMENT

A. The following items must be supplied unless otherwise noted. Proprietary names are to designate performance only. Equal products will be accepted.

1. Ring buoy and extension rope (2 required) – Buoy must be 24-inch diameter vinyl clad PVC foam with a metal ring molded inside. Buoy must have a 3/8-inch polyethylene rope attached to it at four points and be a minimum 60 feet in length. Preserver must be U.S.C.G. approved. Buoy and rope must be mounted at each lifeguard chair on hooks. Ring buoy must be Recreonics #12-252, Lincoln #44-075 or approved equal. The throw rope must be Recreonics #12-261, Lincoln Aquatics #42-050, or approved equal.
2. Life hook and pole (2 required) – Life hook must be an anodized aluminum 3/8-inch OD "shepherd's crook" with a 1-1/8-inch OD handle attachment suitable for a 1¼-inch 16 ft. aluminum extension pole. Hook must be of looped construction. Each pole must be provided with a set of spring type stainless-steel pole clamps for mounting on each lifeguard chair. Life hook must be Recreonics #12-239, Lincoln #42-060 or approved equal. Pole clamps must be Recreonics #10-353, Lincoln #30-135, or approved equal.
3. Spineboards (2 required) - Spineboard must be 72” long x 20” wide, constructed of 100% virgin high density polyethylene. The design must provide stiffness and torsional rigidity while remaining lightweight. The spineboard must accommodate up to 500 lbs and must feature customizable buoyancy that allows users to adjust the buoyancy by inserting polyethylene foam rods (supplied with the spineboard). There must be (10) handholds around the perimeter of the board. The spineboard must be supplied with one (1) 2-piece head immobilizer, one (1) head strap, four (4) body straps, one (1) head immobilizer with head bed, and two (2) flotation rods. The spineboard must be CJ Rescue 6 package as manufactured by CJ spineboard or approved equal. Provide one (1) set of heavy-duty stainless-steel utility hooks per spineboard for storing the spineboard at a convenient and readily accessible location near the pool (Recreonics #10-362 or Lincoln #44-100).
4. First aid kit (1 required) - First aid kit must be a 50-person unit per American Red Cross standards as manufactured by Recreonics #12-050, Lincoln #47-092 or approved equal.
5. Bloodborne pathogen kit (1 required) – Bloodborne pathogen kit must include a protective gown, medical-grade latex gloves, face mask with eye shield, antimicrobial hand wipes, and body fluid clean-up supplies. The kit must include a wall-mountable hard storage case. Bloodborne pathogen kit must be Lincoln Aquatics #48-061 or approved equal.
6. Rescue tube (6 required) - Provide one rescue tube for each lifeguard chair. Rescue tube must be Recreonics #12-293, Lincoln #42-032 or approved equal.
7. Safety eyewash station (1 required) - Safety eyewash station must be a self-contained system in which eyewash bottles are securely positioned in a portable holder. Eyewash bottles must be 32 ounces and easily removable from case, and must contain a sterile, saline solution with the ability to neutralize a varying quantity acids or caustics. Eyewash stations must be equipped with a double back screw and holes for easy mounting in location determined by the Architect. Stations must be Recreonics #12-033, Lincoln Aquatics #49-026, or approved equal.
8. Safety eyeglasses - Provided a safety eyeglass dispenser station containing ten (10) pairs of safety glasses. Eyeglasses must be ANSI/OSHA accepted.
9. Bag Valve Masks – Provide two (2) bag valve mask assistant resuscitation systems, one size Adult (1500ml tidal volume) and one size Infant/Child (450ml tidal volume). Product must be a latex free disposable bag mask unit with support strap, transparent patient

valve, and textured surface to eliminate slipping. Integral swivel valve, available with a closed reservoir system. Standard pack includes resuscitator, oxygen reservoir and a transparent bag for storage. Bag Valve Masks must be Ambu SPUR II or approved equal.

10. Automatic External Defibrillator
    a. Provide one (1) Automated External Defibrillator and one (1) trainer AED corresponding to the chosen AED per facility level for the aquatic facility. Product location must be coordinated with the Owner and Architect. AED must be Recreonics #12-430 or approved equal and must have an available training AED device. The AED Cabinet must be Recreonics #12-434 or approved equal.

2.14 THERMOMETERS

A. The following items must be supplied unless otherwise noted. Proprietary names are to designate performance only. Equal products will be accepted.
   1. Portable thermometer (2 required) must be a molded ABS plastic tube body type with the ability to measure temperature in both degrees Fahrenheit and Celsius. A 3 ft. polyethylene cord must be attached to thermometer. Thermometer must be manufactured by Pac-Fab/Rainbow #R141036, Recreonics #56-112, Lincoln #21-133 or approved equal.
   2. The inline thermometer must be near the heating loop and must have a 9-inch adjustable angle with a minimum 6-inch stem. There must be a minimum of two (2) thermometers per loop and must have ability to read temperature in both degrees Fahrenheit and Celsius. Thermometers must be Recreonics #32-702, Lincoln Aquatics #21-125, or approved equal.

2.15 SWIMMING POOL FINISHES

A. Paint
   1. The interior surfaces of the gutter trough must be painted with a high build epoxy. The color must be white or an approved light color.
   2. The coating must be a low VOC compliant polyamidoamine epoxy suitable for chlorinated water below 3.2 ppm and for installation on concrete surfaces. Coating must be Tnemec L69 Hi Build Epoxoline II, Induron Perma-Clean II Epoxy or approved equal. Color must be white.
   3. Quality Assurance
      a. At least ten (10) commercial public-use pools with individual water surface areas in excess of 4500 square feet of pool surface area or more must have been completed within the past 5 years.
      b. Submit a letter of approval from the pool paint manufacturer prior to application of the pool paint. Provide manufacturer with required estimated square footage to ensure proper material usage.
   4. Surface Preparation
      a. Cast-In-Place Concrete
         1) Allow concrete to cure a minimum of 28 days per ACI 308 and Divion 3 - Concrete. Perform moisture test of the concrete to ensure dryness. Either the plastic sheet method test (ASTM D 4263) or the Anhydrous Calcium Chloride Test (ASTM F 1869) must be performed prior to painting. Document test with pictures and submit results for record. Relative humidity must be measured with a probe and must be less than 75%. The Contractor must document test with pictures and submit results for review/record.

2) Brush-off pool interior surfaces, then blast clean to remove laitance and weak surface concrete, foreign substances and debris that could reduce or impair adhesion, dirt, oil, grease, curing compounds, or other foreign materials, to produce an anchor profile similar to medium grade sandpaper referencing SSPC-SP13/NACE6 and ICRI-CSP 2-4 Surface Preparation of Concrete. Blasting must open up surface voids, holes, and irregularities. No holes or holidays in the paint surface are allowed. Fill holes or irregularities that cannot be satisfactorily painted with an approved grout or Tnemec Series 215 Surfacing Epoxy, Induron EFS707 Epoxy Surfacer and Filler or Induron Mortarchem. Do not entirely remove the surface or completely expose the underlying aggregate.

b. Pneumatically Applied Concrete

1) Allow concrete to cure a minimum of 28 days per ACI 308 and Division 3 - Concrete. Perform moisture test of the concrete to ensure dryness. Either the plastic sheet method test (ASTM D 4263) or the Anhydrous Calcium Chloride Test (ASTM F 1869) must be performed prior to painting. Document test with pictures and submit results for record. Relative humidity must be measured with a probe and must be less than 75%. The Contractor must document test with pictures and submit results for review/record.

2) Prior to applying paint to a pneumatically applied concrete surface, a brown coat plaster leveling surface must be applied. The pneumatically applied concrete surface must be prepared for the application of the brown coat by removing foreign substances and debris that could reduce or impair adhesion, dirt, oil, grease, curing compounds, or other foreign materials. Brown coat must be applied to provide a clean, firm surface similar to a medium grade sandpaper, suitable for the application of paint. No holes or holidays in the paint surface will be allowed. Fill holes or irregularities that cannot be satisfactorily painted with an approved grout or Tnemec Series 215 Surfacing Epoxy, Induron EFS707 Epoxy Surfacer and Filler or Induron Mortarchem.

5. Application Procedures

a. Before applying material, measure and record the temperature and relative humidity. Apply only if surface and air temperature is above 50°F and at no lower temperature than 5°F above the dew point, unless otherwise approved by the manufacturer. Low temperature cure option must be submitted for approval if required. Do not apply when the relative humidity is greater than 85%. If possible, plan the painting schedule so that painting is done in the coolest part of the day. Provide adequate ventilation during application to minimize odor.

b. Protect exposed tile during preparation and application procedures.

6. Application of the First Coat

a. After the pool surface has been thoroughly dried and cleaned the first coat can be applied. Surface spreading rate must be observed as not to exceed the recommended manufacturer’s rate of application. The first coat must be applied at a minimum rate of 200 SF per gallon and must conform to local VOC requirements. First coat must be thinned 10%. The first coat must be allowed to cure for 12 hours at a minimum temperature of 70°F prior to second coat, unless otherwise approved by the manufacturer. Low temperature cure option must be submitted for approval if required.

7. Application of the Second Coat

a. After the first coat dries, the second coat must be applied at a minimum rate of 200 SF per gallon and must conform to local VOC requirements. The second

coat must be allowed to cure for 12 hours at minimum temperature of 70°F prior to final coat, unless otherwise approved by the manufacturer. Low temperature cure option must be submitted for approval if required.

8. Application of the Final Coat
   a. After the second coat dries, the final coat must be applied at a minimum rate of 200 SF per gallon and must conform to local VOC requirements.
   b. The final coat must be allowed to cure for 7 days at 70°F before filling the pool, unless otherwise approved by the manufacturer. Low temperature cure option must be submitted for approval if required.
9. Application of the Finish
   a. Application must be made by brush, roll, lamb's wool applicator or spray.

B. Swimming Pool Cementitious Finish, Diamond Brite, Pebble Sheen - Reference specification section 13 11 04, Swimming Pool Cementitious Finish.

C. Swimming Pool Tile - Reference specification section 13 11 03, Swimming Pool Tile.

2.16 WATERPROOFING

A. Products
   1. Interior surfaces of surge tanks and backwash pit with NO additional finishes: Apply two (2) coats of Vandex BB White, Xypex Modified, Xypex Megamix I, Miracote BC Pro or Basecrete directly to surface of surge tanks and backwash pit.

B. Surface Preparation
   1. Surface must be structurally sound and free of foreign substances and debris that could reduce or impair adhesion. Surfaces must be roughened by sand blasting or water blasting. Shot blasting, scarifying, or grinding can also be accepted methods of surface preparation. Surface defects or holes must be patched per manufacturer's recommendations.
      a. National Plasterers Council Surface Preparation Definitions
         1) Pressure Washing: The washing or cleaning of a surface by a stream of water ejected from a nozzle at high velocity, typically in the range of 1,000 psi – 4,000 psi.
         2) Water Blasting: The cutting, abrading, or removal of a surface or substrate by a stream of water ejected from a nozzle at ultra-high velocity, typically in the range of 10,000 psi – 40,000 psi.

C. Application
   1. Do not apply materials under conditions where the ambient air temperature is less than 40 degrees Fahrenheit, or to a frozen substrate.
   2. The mixing of products, quantities and application procedures must be done in accordance with the manufacturer's recommendations.

2.17 SEALANTS

A. Provide sealed expansion joints as shown on the pool and pool structural drawings or noted on the construction/expansion joint layout, and as required. Expansion joints must be constructed and sealed as indicated and in accordance with the manufacturer's recommendation. Sealant must be manufactured by LATICRETE International, Inc., Mapei, or Deck-O-Seal. If submerged joints are provided within a pool structure that utilizes a cementitious finish, a 2"x2" tile trim must be installed adjacent to the sealant on each side of the joint. Reference specification section 13 11 03, Swimming Pool Tile.

1. For submerged joints:
    a. Latasil, one component, neutral cure, high performance, 100% silicone sealant in the color(s) as selected by the Owner/Architect. Must be used in conjunction with Latasil 9118 Primer per manufacturer's recommendations.
    b. Mapesil T, 100% silicone sealant in the color(s) as selected by the Owner/Architect.
2. For joints behind the coping, or other horizontal deck joints:
    a. Deck-O-Seal, two component (gun-grade or pourable, self-leveling), high resilience, non-sag, non-flowing, polysulfide-based sealing compound in the color(s) as selected by the Owner/Architect. Must be used in conjunction with Rezi-Weld LV per manufacture's recommendations.

B. Material Storage
1. Materials must be stored in the original unopened factory containers in a cool dry location at 60 to 80 degrees F. Protect from the elements and the hazards of construction.

C. Joint Preparation
1. Clean the joints of deleterious material, to sound, clean and dry substrate.
2. Joint must be formed or filled with an approved, resilient, non-asphaltic, closed cell, polyethylene joint filler material down to firm substrate. Allow space at the top of the joint for the installation of approved closed cell polyethylene backer rod and install same to the required depth below the surface of the slab to control the depth of the sealant bead to within manufacturer requirements.

D. Surface Preparation
1. Concrete surfaces to receive sealant must be fully cured, clean, dry, and free of dirt, dust, curing compounds and other foreign material that might compromise the adhesion and performance of the sealant. Curing aids, form release agents and joint former residue must be completely removed, if necessary, by sand blasting and/or grinding. Loose dust must be brushed off.
2. Prime surfaces to receive Latasil sealant with Latasil 9118 Primer prior to sealant application, and surfaces to receive Deck-O-Seal sealant with P/G Primer prior to application.

E. Application
1. Apply sealant in accordance with the manufacturer's recommendations.
2. Tool the joint immediately after application to ensure a firm, intimate contact with the joint interface.
3. Remove excess sealant and smear from adjacent surfaces with Xylol or Toluol before sealant cures.
4. After the sealant has fully cured (generally a minimum period of five days at 72 degrees and 50% humidity), paint the surface of the sealant with a chlorine resistant chlorinated rubber or equivalent pool paint, in a compatible color as selected by the Owner/Architect. NOTE: Latasil cannot be painted.

2.18 UNDERWATER LIGHTS

A. Underwater lights must be equivalent to 100/500 watts of incandescent light. Underwater lights must be UL listed and, in the quantities, shown and as detailed in the construction drawings and as described in these specifications. Coordinate for proper installation. Refer to the drawings for quantities and locations.

B. The pool underwater lights must be 120VAC or 12VAC, 31 watts LED-type, and equivalent to 500 watts of incandescent light. Fixture housing must be stainless-steel construction with minimum wall thickness of 0.020 inch per UL 676 underwater pool lighting standard. The niche must be stainless-steel with cast brass mounting ring or PVC plastic with stainless-steel mounting ring. Brass construction pressure grounding lug on interior and exterior services. Lens must be 8-3/8 diameter clear tempered heat resistant glass. The gasket must be single piece "U" shaped santoprene or silicone. Fasteners must be silicon-bronze or stainless-steel. The light fixture must be supplied with a #16-3 STW (120V) or 12-3 SJTW (12V) submersible cord with ground wire positively grounded inside the fixture. Cord entrance must be a watertight seal and epoxy encapsulated. Light fixture must be IntelliBrite Architectural Series White LED pool light series by Pentair Commercial Pool and Aquatics or approved equal. Underwater lights must be provided with cord length as required to allow for deck relamping of fixtures.

C. The spa underwater lights must be 120VAC or 12VAC, 18 watts LED-type, and equivalent to 100 watts of incandescent light. Fixture housing must be stainless-steel construction with minimum wall thickness of 0.020 inch per UL 676 underwater pool lighting standard. The niche must be stainless-steel with cast brass mounting ring or PVC plastic with stainless-steel mounting ring. Brass construction pressure grounding lug on interior and exterior services. Lens must be clear tempered heat resistant glass. The gasket must be single piece "U" shaped santoprene or silicone. Fasteners must be silicon-bronze or stainless-steel. The light fixture must be supplied with a #16-3 STW (120V) or 12-3 SJTW (12V) submersible cord with ground wire positively grounded inside the fixture. Cord entrance must be a watertight seal and epoxy encapsulated. Light fixture must be IntelliBrite Architectural Series White LED spa light series by Pentair Commercial Pool and Aquatics or approved equal. Underwater lights must be provided with cord length as required to allow for deck relamping of fixtures.

D. Junction boxes must be provided in the quantities required and must be located at least 8” above the pool coping and 5' from the pool edge. Refer to the Electrical drawings. Cord length must be sufficient to run from fixture to the junction box with sufficient cable in the niche to re-lamp the fixture on the deck. Provide junction boxes that must be installed by Electrical.

E. Transformers for 12V underwater lights must be Intermatic PX Series low voltage landscape and swimming pool/spa light transformer or approved equal as specified by Electrical designer. These safety transformers are specifically designed to supply 12 volts to pool/spa lights, submersible fixtures, and outdoor garden lights. The built-in circuit protection will disconnect power to the transformer in case of defect or overload. These transformers are suitable for direct connection to underwater pool and spa lights. Refer to manufacturer information for cabling distance and gauge requirements. Coordinate transformer locations with Electrical.
   1. Model PX100 and PX100S: 100 W Transformers - input 120 VAC, output 12 VAC or 13 VAC
   2. Model PX300 and PX300S: 300 W Transformers - input 120 VAC, output 12 VAC, 13 VAC, or 14 VAC

2.19 WATER FEATURES AND SUPPORT EQUIPMENT

A. Provide water features in the quantities shown in the drawings by Waterplay, Vortex, or approved equal manufacturer. Waterplay features are basis of design.

B. 0010-3651 Restorative Spray 1
   1. Characteristics: The Restorative Spray 1 consists of a straight lower column and an upper column with a 15° bend and shall be constructed of schedule 10 stainless steel

structural tubing. A two (2) piece fan assembly constructed of stainless steel show be welded to the upper column mount. The fan plates narrows at the opening to restrict and direct the flow of water. Tamper resistant fasteners shall be used to hold all components together to prevent leakage. Water shall flow through the fan head in a flat, dispersed spray

2. Dimensions: The overall height of the structure shall be no less than 126 inches (32000mm) The overall height of the structure shall be no less than 71 inches (1803mm) above final grade. The overall width of the structure shall be no less than 43 x 11 inches (1092 x 279mm)
3. Recommended Flow Rate: The hydraulic requirements shall be 30 gpm @ 4 psi (114 lpm @ 28 kpa).
4. Anchoring/Levelling System: See Playphase Base Medium written spec for more detail.

C. 0010-7496 GS Spray Tunnel 4

1. Characteristics: The four (4) spray canisters shall be connected to a 58 inch (1473mm) diameter base pipe that works as a distribution manifold. Each canister shall be no less than 6 inches (152mm) tall with a diameter of Ø2.88 inches (73mm). The Acetal spray nozzles and winter caps shall be seated into the canister with an o-ring and secured using tamper resistant security bolts. Tamper resistant winter caps are included. All nozzles sit flush with final grade. There shall be one 1.5 inch (38mm) National Pipe Thread water inlet located at the end of the base pipe.
2. Dimensions: Flush to grade mount with an overall height of 8 inches (203) and length of 58 inches (1473mm)
3. Recommended Flow Rate: The hydraulic requirements shall be 24 gpm @ 5 psi (91 lpm @ 34 kpa).
4. Nozzle Count: Four (4)
5. Water Display: Water will flow through four (4) 2.5" acetal nozzles. If restriction is placed on any nozzle, the flow and height on the remaining nozzles will increase.

2.20 POOL HEATERS

A. Provide the pool water heating system. Heating system to include piping, heaters, booster pumps, controls, gauges, thermostats, control valves and wiring required to draw water from the recirculation piping, heat the water and return it back to the recirculation piping. Interlock pool heating system with pool recirculation pumps.

1. Pool heater manufacturer representative must be on site to start and adjust pool heater(s). Copies of the startup report must be sent to the Architect/Engineer.
2. The heater(s) system must consist of a direct gas fired boiler boiler with an internal pumped bypass as shown on the drawings. Proposed substitutions must include a mechanical drawing incorporating required changes in layout, piping valves, gas, venting and electrical connections. The cost of such changes must be included in the price of the substitute. Confirm by 1/4-inch scale shop drawing that the alternate heater(s) must be provided will fit within the available space.
3. The pool heater(s) must have an input rating as shown on the drawings and must be orificed for operation on Natural Gas.

B. Direct Gas Fired Boiler (without Pumped Bypass)

1. Basis of Design: Lochinvar ERN, RayPak Professional Series or approved equal.
   a. The heater water containing section must be of a "Fin Tube" design, with straight cupro nickel tubes having extruded integral fins spaced seven (7) fins per inch. The tubes must terminate into a one-piece rear header and a two-piece front header with an integral bypass assembly. The front header

configuration must allow access to the heat exchanger for the purposes of inspection, cleaning, or repair. The heat exchanger must have a drain for proper draining and winterization. The front header must provide a 3/4" NPT connection for a field installed relief valve. Connection may be made directly to the front header with CPVC pipe. The heat exchanger must be mounted in a stress-free jacket assembly in order to provide a "free floating design" able to withstand the effects of thermal shock.

b. The heater must be constructed to the requirements of the American Society of Mechanical Engineers and bear the “HLW” stamp with a 125 PSI working pressure and must be National Board Listed. The bronze front header assembly must mount with bolts and seal with an EPDM gasket.
c. The combustion chamber must be sealed and completely enclosed with ceramic fiberboard insulation. The material must provide a high efficiency insulation barrier while providing low weight. The burners must be constructed of high temperature stainless steel and fire on a horizontal plane. The heater must have an integral combustion air blower to precisely control the fuel/air mixture for maximum efficiency. Operation of the combustion air blower and venting system must be monitored by an air proving switch.
d. The heater(s) must be constructed with a heavy gauge pre-painted galvanized steel exterior jacket assembly. Steel jacket components must be galvanized on both sides.
e. The heater(s) must be certified and listed by CSA International under the latest edition of the appropriate ANSI test standard. The heater(s) must comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The heater(s) must operate at thermal efficiency up to 87%.
f. The heater(s) must be furnished with an integral bypass assembly to ensure proper operation without condensation. The bypass assembly must be constructed with corrosion resistant materials for long life. The bypass must automatically control water flow rates through the heat exchanger. No auxiliary bypass is required unless water flow rates exceed 100 GPM.
g. Standard operating controls must include a digital electronic thermostat with independent settings for pool temperature control. The electronic temperature control must ensure accurate temperature control to ±1°F. A pool water safety high limit control must be provided. The heater(s) must have a master on/off switch.
h. The heater(s) must be field convertible to operate on either 120 VAC or 240 VAC. The control system must include a direct-spark ignition system. The ignition system must provide flame supervision for 100% safety shutdown. The heater(s) must be equipped with a digital display to provide the status of operation and troubleshooting assistance on a control sensed malfunction. The heater(s) must be provided with a built-in low water pressure switch to monitor water flow.
i. The heater(s) must have an independent laboratory rating for Oxides of Nitrogen (NOx) of less than 30 ppm corrected to 3% O2.
j. The heater(s) must be approved for indoor installation. The heater(s) must be supplied with venting and air intake in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 latest edition. Refer to Mechanical drawings for required air intake and venting configuration to include with the heater(s).

C. Direct Gas Fired Boiler (with Internal Pumped Bypass)
1. Basis of Design: Lochinvar Copper-Fin 2, Raypak HiDelta, or approved equal.

a. The water containing section must be of a "fin tube" design, with cupro-nickel tubes having extruded integral fins. The tubes must terminate into a one piece, lined, bronze header. There must be access to the front header of the heat exchanger for the purposes of inspection, cleaning, or repair. The heat exchanger must be mounted in a stress-free jacket assembly in order to provide a "free floating design" able to withstand the effects of thermal shock. The heater(s) must bear the ASME "H" stamp for 160 psi working pressure and must be National Board listed.

b. The combustion chamber must be sealed and completely enclosed with a ceramic fiberboard insulation. A burner/flame observation port must be provided on each end of the unit. The burners must be constructed of a high temperature stainless steel and fire on a horizontal plane. The heater(s) must have a multi-speed combustion air blower to precisely control the fuel/air mixture for maximum efficiency.

c. The heater(s) must be constructed with a heavy gauge galvanized steel jacket assembly, primed and pre-painted on both sides with a minimum dry film thickness of 0.70 mils. The jacket design must allow single unit venting connection without the use of external draft hood devices.

d. The heater(s) must be certified and listed by CSA International under the latest edition of the appropriate ANSI test standard. The heater(s) must comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The heater(s) must operate at thermal efficiency up to 85% (HiDelta 83%). The heater(s) must be ASME inspected, and HLW-stamped and National Board registered for 160 PSIG working pressure, complete with a Manufacturer's Data Report.

e. Heat Exchanger
   1) The heat exchanger must be of a single-bank, horizontal-grid design with integral cupro-nickel finned tubes, each end of which is rolled into an ASME boiler-quality steel tube sheet. The heater(s) must be capable of operating at inlet water temperatures as low as 105°F without condensation.

f. The heater(s) must be furnished with a factory supplied pumped bypass assembly to ensure proper operation without condensation. The bypass assembly must include a sealed bronze pump. The bypass assembly must be constructed of schedule 80 CPVC piping with brass inserts and an automatic three-way valve to protect the unit against inlet water temperatures that would cause the heat exchanger to condense.

g. The heater(s) must have an independent laboratory rating for Oxides of Nitrogen (NOx) of less than 30 ppm corrected to 3% O2.

h. The heater(s) must be equipped with a controller incorporating software customized for operation of the heater(s). Internal safety, operating and ignition controls must be included in the controller. The controller must provide on/off control of the gas supply to the burner, operation of the combustion air blower, ignition of the gas-air mixture, flame proving, control of water temperature set points, and monitoring of safety functions.

i. The heater(s) must feature an LED/LCD display that provides external heater(s) status/faults. Local communication, programming, and a display of operating and alarm status conditions must be accessible through the control panel. The control panel must contain an on/off main power switch, a digital display of temperature functions, the operational status of the heater(s), or an active alarm fault.

j. The heater(s) must allow 0-10 VDC input connection for BMS control. Supply voltage must be 120 volt / 60 hertz / single phase.
k. The control system must include redundant proven pilot hot surface ignition with full flame monitoring capability. Multiple main gas valves with redundant valve seats and built-in low gas pressure regulators must be supplied as standard. Gas valves will be referenced to the combustion chamber to ensure proper air/gas mixture for efficient combustion.
l. The heater(s) must be approved for indoor installation. The heater(s) must be supplied with venting and air intake in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 latest edition (Category I). Refer to Mechanical drawings for required air intake and venting configuration to include with the heater(s).
m. Heater Stacking Kit
    1) The heater(s) must be stacked directly one on top of the other as shown on the drawings. Stacking kit must be provided by heater(s) manufacturer to minimize footprint.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS, INSPECTION AND PREPARATION

A. Carefully examine the contract documents for requirements that affect the work of this section. Prior to starting work, notify the Architect of defects requiring correction. Do not start work until conditions are satisfactory.

B. Verify that work by others, related to this section, has been completed. This includes earthwork, concrete work, and mechanical, electrical, and plumbing connections.

C. Protect materials and work completed by others from damage while completing the work in this section.

3.2 FIELD MEASUREMENTS

A. Verify benchmark and pool location prior to layout.

B. If field measurements differ from the construction drawing dimensions, notification must be given to the Architect prior to proceeding with work.

3.3 EXCAVATION, REINFORCING STEEL AND SWIMMING POOL SHOTCRETE OR CAST-IN-PLACE CONCRETE

A. Reference Division 31 - Earthwork

B. Reference Division 3 - Concrete

3.4 TOLERANCES FOR CONSTRUCTION OF THE POOL SHELL

A. The completed structures must be constructed level and to the dimensions, elevation, depths, and thickness as shown on the plans.

B. The elevation tolerance of the pool shell and gutter lip must be plus or minus 1/8 inch.

C. The vertical wall surface tolerance of the pool shell, for the first 36 inches from the water surface must be plus or minus 1/4 inch from plumb measured with a 6-foot straight edge.

D. For competitive racecourses, the following pool shell tolerances must apply:

Course	Tolerance	Minimum	Maximum
25 Yard	+ 1 3/16” /- 0”	75’ – 3/4”	75’ – 1 15/16”

1. The above dimensions include allowances for a touchpad at each end of the course. The maximum dimension includes the construction tolerance. These above tolerances also apply to courses utilizing moveable bulkhead(s).
2. The above dimensions apply to a vertical plane extending 1’-0” above and 3’-0” below the surface of the water at points of both end walls.

E. Provide the services of a registered engineer or land surveyor who must measure and certify the elevations of the gutter lip at 10-foot centers. Courses designed with touchpads for competition must be measured and certified with touchpads in place. Course length survey must be made with the pool filled with water between 78- and 82-degrees Fahrenheit. The Contractor to submit compliant survey measurements to the Architect for review and record.

F. Ground wires or grade pins, if used, must be installed in such a manner that they accurately outline the section of the pool shell as indicated on the plans. They must be located at intervals sufficient to ensure proper thickness throughout and must be maintained tight. Grade pins or grounding wires must not be permanently embedded in the pool shell.

3.5 PIPING INSTALLATION

A. General
1. Provide and erect, according to the best practices of the trade, piping shown on the drawings and required for the complete installation of these systems. The piping shown on the drawings must be considered as diagrammatic in indicating the general run and connections and may or may not in parts be shown in its true position. The piping may have to be offset, lowered, or raised as required or as directed at the site. This does not relieve responsibility for the proper erection of the systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Architect. In the erection of piping, it must be properly supported, and proper provisions must be made for expansion, contraction and anchoring of piping. Piping must be cut accurately for fabrication to measurements established at the construction site. Pipe must be worked into place without springing and/or forcing, properly clearing windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted. Pipes must have burrs and/or cutting slag removed by reaming or other cleaning methods in strict accordance with the manufacturer's instructions. Changes in direction must be made with fittings. Open ends of pipes and equipment must be properly capped or plugged to keep dirt and other foreign materials out of the systems. Plugs of rags, wool, cotton waste or similar materials will not be used in plugging. Piping must be arranged so as not to interfere with removal and maintenance of equipment, filters, or devices, and so as not to block access to manholes, access openings, etc. Flanges or unions applicable for the type of piping specified must be provided in the piping at connections to items of equipment. Piping must be installed to ensure noiseless circulation. Valves and specialties must be so placed to permit easy operation and access.

B. Pipe Hangers and Supports
1. Pipes must be adequately supported by pipe hangers and supports as specified.

2. Horizontal PVC Schedule 80 piping must be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 120-degree F and as listed below:

Nominal Pipe Size	Hanger Support Spacing	Minimum Rod Size for Single Rod Hanger
1-1/4" and less	5'-0"	3/8"
1-1/2" to 3"	6'-0"	1/2"
4" to 6"	8'-0"	5/8"
8" to 12"	10'-0"	7/8"
Greater than 12"	12'-0"	1"

3. Horizontal CPVC Schedule 80 piping must be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 140-degree F and as listed below:

Nominal Pipe Size	Hanger Support Spacing	Minimum Rod Size for Single Rod Hanger
½" and less *	4'-0"	3/8"
¾" to 2"	6'-0"	3/8"
2-1/2" to 3"	7'-0"	1/2"
4" to 8"	8'-0"	7/8"
Greater than 12"	10'-0"	1"

4. Round rods supporting the pipe hangers must be of the following dimensions:

Nominal Pipe Size	Rod Diameter
1/2" to 2" pipe	-3/8" rod
2-1/2" to 3" pipe	-1/2" rod
4" to 5" pipe	-5/8" rod
6" pipe	-3/4" rod

5. Hanger rods must be galvanized steel. Provide for controlling level and slope by turn buckles or other approved means of adjustment and incorporate lock nuts.
6. Provide means of preventing dissimilar metal contact such as plastic-coated hangers, copper colored epoxy paint, or non-adhesive isolation tape.
7. Provide hangers to provide a minimum of 1-inch space between finished covering and adjacent work.
8. Place a hanger within 12 inches of each horizontal elbow.
9. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
10. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified. Trapeze hangers must be spaced according to the smallest pipe size or provide intermediate supports according to the support spacing schedules. Provide heavier members as required for the load supported for the entire span distance. Hanger rods must be as specified above and properly sized for the load supported, but not less than 5/8 inches diameter.
11. Piping must be rigidly supported from the building structure by means of hanger assemblies properly selected and sized for the application in accordance with the manufacturer's recommendations and specifications. Do not support piping from other pipes, ductwork or other equipment that is not building structure. Do not modify the building structure for hanger installation.
12. Attachment of piping hangers to the building structure must be provided in a manner approved by the Architect. Provide concrete inserts installed by others in the building construction at the time the concrete is poured, and hangers must be attached to these inserts.

13. The use of pipe hooks, chains, or perforated iron for pipe hanger supports will not be permitted.
14. A design for piping in a service tunnel, if required, supported by a structure must be submitted for approval. The structure must be non-corrodible and must be of a size and configuration to rigidly support the piping as shown in the plans at a minimum spacing as shown below.

C. Concrete Inserts
1. Provide inserts for placement in form work before concrete is poured.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Where concrete slabs form finished ceilings, inserts must be flush with the slab surface.
4. Provide hook rods to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Piping Installation – Below Grade
1. Trench bottoms must be smooth and free of rocks and debris. If the trench is dug in ledge rock, hardpan or where large boulders are not removed, place 3 inches of sand or compacted fine-grained soil below the pipe. Pipe must be supported over its entire length with firm, stable material. Blocking will not be used to change pipe grade or provide intermittent support over low sections in the trench. Surround the pipe with backfill meeting the requirements of Section 31 20 00 with a particle size of 1-1/2 inch or less and in accordance with the project geotechnical report. Compact in layers not to exceed 6 inches with vibratory method. Follow installation methods of ASTM D2774 "Underground Installation of Thermoplastic Pressure Piping".

E. Flushing, Draining and Cleaning Pipe Systems
1. Flush out water systems with water before placing them in operation. Other systems must be cleaned by using compressed air or nitrogen. After systems are in operation and during the test period, strainer screens must be removed and thoroughly cleaned.

F. Expansion and Contraction
1. Make necessary provisions for expansion and contraction of piping with offsets, loops, flexible connections, and anchors as required to prevent undue strain. Provide shop drawings for method and arrangement for control of expansion and contraction of piping.

G. Testing
1. Piping installation and pressure testing must be performed by the Contractor and reviewed by the Owner or a designated representative of the Owner before commencement of backfilling. A minimum one (1) week notice must be provided prior to review. Results must be submitted to the Architect. Pictures with time stamps for each section of piping must be included with testing report(s) and be submitted within one (1) week of the pressure test(s).
2. Suction and supply pool piping must be capped and hydraulically pressure tested with water to a pressure of not less than 50 PSI for a period of no less than two (2) hours. Pressure testing must be conducted in accordance with ASTM D2774. The temperature of the water used for the test must be between 40ºF and 90 ºF.
3. Gravity pool piping must be capped and hydraulically pressure tested with water to a pressure of not less than 20 PSI for a period of no less than two (2) hours. Pressure testing must be conducted in accordance with ASTM D2774. The temperature of the water used for the test must be between 40ºF and 90 ºF.
4. Pneumatic testing (air) of any pool piping will not be accepted.

5. The Contractor must verify recirculation fitting pressure limitations can meet testing requirements prior to installation and testing. Piping may be tested prior to a recirculation fitting connection (skimmer, main drain, etc.) within 5’-0” of connection point.
6. Maintain a sustained 20 PSI pressure on pool related piping throughout the course of construction.
7. Adhere to the applicable provisions of Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.

3.6 EQUIPMENT AND SYSTEMS INSTALLATION

A. Provide and assemble equipment, special parts and accessories as shown on pool drawings, specifications, and shop drawings of the equipment suppliers.

B. Provide anchors and inserts imbedded in the deck including fittings, inserts and structure sleeves and required anchorage as shown on the plans and as indicated in this section of the specifications. Equipment must be set true and plumb, using factory jigs where available. Removable equipment items must be easily removable from anchors and must fit without noticeable wobble.

C. Provide templates for equipment anchors. Provide anchor bolts of the size and spacing as required by the equipment manufacturer. Anchor bolts must be stainless-steel Type 316L and of a length capable of adequate anchorage into rough slab-on-grade allowing for finish deck tile and setting bed. Anchors must be set and cast into place during building concrete work. Inspect anchor settings for horizontal and vertical alignment prior to placing concrete.

D. Provide equipment and systems in accordance with manufacturer's directions. Equipment must be assembled and in place for final observation.

E. Items necessary to complete this section are shown on the plans or described in the specifications including items that may be purchased by the Owner. Items are detailed and specified as a guide for dimensional purposes. Make provisions accordingly and submit shop drawings and submittals based on that data.

3.7 START-UP AND INSTRUCTION

A. Supply the services of an experienced swimming pool operator/instructor for a period of not less than two days (total 16 hours) after the pool(s) have been filled and initially placed in operation. During this period, the Owner's representatives who will be operating the pool(s) must be thoroughly instructed in phases of the pool's operation. Deliver six (6) complete sets of operating and maintenance instructions for the swimming pool, structures, finishes and component equipment. Prior to leaving the job, obtain written certification from the designated Owner's representative acknowledging that the instruction period has been completed and necessary operating information provided. Include the cost of two (2) additional days (total 16 hours) of instruction and operational check out by the qualified representative during the first season of operation.

B. Written reports of each of these visits outlining the pool's operation, competence and performance of the pool's operation personnel, and other pertinent comments must be submitted to the Owner and Architect/Engineer within one (1) week after each visit.

C. Provide specific written procedures that must be followed for emptying and refilling the pool as mentioned previously in this section. The procedures must be included in the bound volume of

operating instructions and references in the front index with a note headed by the words: "CAUTION -- VERY IMPORTANT".

END OF SECTION 13 11 00

SECTION 13 11 03 - SWIMMING POOL TILE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and General Provisions of the contract, including General and Supplementary Conditions apply to the work of this section.

1.2 SUMMARY

A. The cementitious pool finish must have ceramic tile markings and trim at locations including the pool perimeter tile band, vertical tile band, stairs, nosings, recessed wall steps, toe ledge, depth markings, wall targets, floor lane markings, construction joint installations bands and other tile installations as shown and detailed on the contract drawings and in strict accordance with these specifications.

B. Provide a ceramic tile finish on the entire interior surface of the spa.

C. The Contractor must furnish and install the work of this section.

1.3 RELATED SECTIONS

A. Division 1 – Mock Ups

B. Division 7 - Joint Sealers

C. Division 9 - Ceramic Tile

D. Section 13 11 00 - Swimming Pool

E. Section 13 11 04 - Swimming Pool Cementitious Finish

1.4 QUALITY ASSURANCE

A. Reference Standards: Conform to the following standards unless otherwise required herein.
   1. American National Standards Institute (ANSI)
      a. A108.01 – General Requirements: Subsurfaces and Preparations by Other Trades.
      b. A108.02 – General Requirements: Materials, Environmental, and Workmanship.
      c. A108.1, Glazed Wall Tile, Ceramic Mosaic Tile, Quarry Tile and Paver Tile installed with Portland Cement Mortar.
      d. A108.1C – Contractor’s Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry Set or Latex-Portland Cement Mortar.
      e. A108.5 – Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
      f. A108.6 – Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy for the Epoxy Grouting Installation Process.

g. A108.10 – Installation of Grout in Tile Work.
h. A137.1 Standard Specifications for Ceramic Tile.

2. American Society for Testing and Materials (ASTM)
   a. C144-99, Aggregate for Masonry Mortar
   b. C150-00, Portland Cement
   c. C171-97a, Sheet Materials for Curing Concrete
   d. C206-97, Finishing Hydrated Lime
   e. C207-91 (R1997), Hydrated Lime for Masonry Purposes
   f. F-1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
   g. F-2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes
3. Tile Council of North America (TCNA); 2021 Edition, Handbook for Ceramic Tile Installation.
4. American Concrete Institute
   a. ACI 302 – Guide for Concrete and Floor Slab Construction
5. International Concrete Repair Institute (ICRI)
   a. Concrete Surface Profile (CSP)

B. The Contractor must have two years' experience in similar pool projects for which the Owner may require written proof thereof and proper tools to install tile.

1.5 MANUFACTURERS

A. Subject to compliance with requirements provide ceramic tile, mortar, and grout of the following manufacturers: American Olean Tile Co. (tile), Dal-Tile Co. (tile), Buchtal (tile), KlinkerSire (tile), MAPEI, Inc. (thin-set, waterproofing, grout, and admixtures), and LATICRETE International Inc. (thin-set, waterproofing, grout, and admixtures) or approved equal.

1.6 SUBMITTALS

A. Submit shop drawings indicating tile layout, patterns, joint layout, color arrangement, perimeter conditions, junctions with dissimilar materials, thresholds and setting details.

B. Submit product data indicating material specifications, characteristics, and instructions for using adhesives and grouts.

C. Samples:
   1. Submit physical samples for all tile color selections by Owner/Architect.
   2. Submit physical samples for grout color selections by Owner/Architect.

D. Mockups:
   1. Mount tile and apply grout on 24"x24" backerboard to indicate pattern, color variation and grout joint size variations of each pattern. Furnish mounted tile samples as requested by the Architect/Owner for approval.

E. Submit manufacturer's installation instruction.

F. Submit maintenance data.
   1. Include recommended cleaning and stain removal methods, cleaning materials.

1.7 PRODUCT DELIVERY AND STORAGE

A. Deliver tile materials to site in unopened factory containers sealed with grade seals bearing printed name or manufacturer and the words "Standard Grade". Keep the grade seals intact and containers dry until tiles are used. Keep cementitious materials dry until used.

1.8 JOB CONDITIONS

A. Inspect and verify job conditions. Report defects in base surfaces for correction before proceeding.

B. Maintain environmental conditions, including temperature humidity and ventilation, within limits recommended by the manufacturer. Do not install products under environmental conditions outside the manufacturer’s absolute limits.

C. Do not install mortar, set, or grout tile exterior when inclement weather conditions are expected within 48 hours after work is scheduled to be completed unless proper protection is provided.

D. Maintain a temperature range of 50 degrees Fahrenheit to 90 degrees Fahrenheit during installation of tile and grout materials. Tile installation should cure for a minimum 14 days with average a temperature of 70 degrees, while maintaining the minimum 40 degrees and maximum 90 degrees Fahrenheit, prior to filling pool with water.

E. Vent temporary heaters to outside to avoid carbon dioxide damage to the new tile work.

1.9 COLORS

A. Colors must be selected by the Owner/Architect or Interior Designer. Note that swimming pool regulations may dictate color selections within the pool tank. See tile materials for price group breakdowns.

1.10 WARRANTIES

A. The Contractor warrants to the Owner that materials and equipment provided under the contract will be of good quality and new unless otherwise required or permitted by the contract documents, that the work will be free from defects not inherent in the quality required or permitted and that the work will conform with the requirements of the contract documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor’s warranty excludes remedy for damage or defect caused by abuse, improper or insufficient maintenance, improper operation, modifications not executed by the Contractor or improper wear and tear under normal usage. If required by the Owner, provide satisfactory evidence as to the kind and quality of materials and equipment. Warranties must be for a period of five years, unless otherwise specified.

B. Setting materials must be provided by the same manufacturer. Mixing materials and application procedures must be done in accordance with manufacturer’s recommendations and requirements. Documentation must be provided to this effect by the Contractor with verification from the manufacturer. This documentation must be included in the operations and maintenance manual under warranties as documentation qualifying the project for a 15 Year Systems Warranty by LATICRETE International, Inc., MAPEI, Inc. or approved equal.

C. The Contractor must contact the tile setting material manufacturer’s technical representative to review installation details, job site conditions, selected materials, and their conformance to the manufacturer’s warranty requirements prior to the commencement of work. Failure to

follow these requirements will not relieve the Contractor of the requirement to provide specified warranties.

D. The Contractor must agree to repair or replace work at no cost to the Owner upon written notification from the Owner within the warranty period. Pro-rated warranties are not acceptable.

PART 2 PRODUCTS

2.1 TILE MATERIALS

A. Standard grade conforming to ANSI A137.1. Provide trim units as indicated and specified, including special shapes as detailed or required. Tile patterns and colors must be as indicated and specified, colors of approved shades. Mesh mounted or perforated paper backed tile is not allowed where the mesh of paper remains as a permanent part of the installation. If dot mounting is used, a minimum of 67% of the depth of the tile must be free from dots to ensure proper grout curing.

B. Porcelain Mosaic Tile
   1. Slip-resistant porcelain mosaic tile, cushion, or all-purpose edges, 2” square for floor, walls, and stair treads unless otherwise noted below. The minimum dynamic coefficient of friction must be 0.42 for wet surfaces and 0.65 for ramped surfaces. Where special shapes are required, they must be selected from price group 1-4. Equivalents provided by Knoxtile, Dal-Tile or American Olean. For wet surfaces: Dal-Tile Keystones matte 2”x2” (price group 1-3), Buchtal Chroma Mosaics with front mount film 2”x2” (seven color options) 7161HVF or American Olean Unglazed color-body 2”x2” (price group 1-3). For ramps: Buchtal Chroma non-slip mosaics with glass fiber net (four color options) 2”x2” 7161H, Dal-Tile Keystones matte 2”x2” (price group 1-3) with abrasive grain or American Olean Unglazed color-body mosaics 2”x2” with abrasive grain (7 color options). Colors, blends and patterns must be selected by the Owner/Architect.
   2. Tile band at the waterline, toe ledge and recessed steps with color, blends and patterns selected by Owner/Architect must be Dal-Tile Keystones Matte, 2”x2” (price group 1-4), American Olean Unglazed color-body 2”x2” (price group 1-4), or powder glazed 2”x2” Buchtal Chroma Mosaics provided by Knoxtile.
   3. Tile deck band that contains the depth marker letters and numerals, warning signs and the 15-meter resurfacing markers with color, blends and patterns selected by the Owner/Architect must be Dal-Tile Keystones Matte or Criss Cross, 2”x2” (price group 1-4) or American Olean Unglazed color-body 2”x2” (price group 1-4).
   4. Contrasting nosing at pool stairs, recessed steps, toe ledge, underwater bench, spa steps, and spa bench must be Universal Trim 2”x2” with color selected by the Owner/Architect from Dal-Tile Keystone Matte (price group 1-2), American Olean Unglazed color-body 2”x2” (price group 1-2).
   5. Recessed steps and toe ledge must be Universal Trim 2”x2” with color selected by the Owner/Architect from Dal-Tile Keystone Matte (price group 1-4), American Olean Unglazed color-body 2”x2” or 1”x1” (price group 1-4).
   6. Contrasting tile strip, wall targets and lane markings on the pool floor with color selected by Owner/Architect from Dal-Tile Keystone Matte 2”x2” (price group 3-4), American Olean Unglazed color-body 2”x2” (price group 3-4), or from Knoxtile 2”x2” Mosaic 7160HVF 5535 Grey Black. The main racecourse wall targets and lane markings must be black.
   7. Tile band adjacent to all submerged construction joint installation bands with color selected by Owner/Architect from Dal-Tile Keystone Matte, 2”x2” (price group 1-2),

American Olean Unglazed color-body 2”x2” (price group 1-2), or powder glazed 2”x2” Buchtal Chroma Mosaics provided by Knoxtile.

8. Tile at top horizontal plane of the spa and vertical face of the spa exterior and spa waterline tile with color, blends and patterns selected by Owner/Architect from American Olean Unglazed color-body 2”x2” (price group 1-4), DalTile Keystone Matte 2”x2” (price group 1-4) or from Knoxtile: Buchtal Chroma Mosaics 2”x2” 7161HVF (seven color options) or non-slip 7161H 2”x2”.

C. Handhold tiles at pool perimeter must be C701 available from Dal-Tile or American Olean. Color selection by Owner/Architect (price group 1-4). Trim pieces for C701 are as follows: SCR701 (Right Termination Piece), SCL701 (Left Termination Piece), CK701 (Inside Corner), and CC701 (Outside Corner).

D. Provide tile trim units where indicated or necessary for a complete and finished installation. Provide rounded units for external and internal corners and angles. Provide trim units of material and finish identical to the adjoining tile.

E. Provide SCR/L701 units where the C701 hand hold is interrupted to permit draining and at all edges/corners. Color selection by Owner/Architect (price group 1-4). The Contractor should request via non-standard production. The SCR/L701 units are available through DalTile at 314-997-6970 or 1-800-672-2086.

F. Message Tile and Depth Markings

1. Horizontal and vertical depth markings and warning signs must be 6”x6” with 4” high numbers and letters. Horizontal depth markers must be slip resistant. Single tile abbreviations must be used for ‘FT’ and ‘IN.’

2.2 Swimming Pool / SPA Tile Setting Materials and Installation

A. Surface Preparation

1. Surface preparation must be in accordance with ACI 302. The surface must be structurally sound and free of foreign substances and debris that could reduce or impair adhesion, free of dirt, oil, grease, curing compounds, or other foreign materials. Sound and remove loose concrete to firm substrate. Surfaces must be roughened to a CSP of 3 to 5 (reference ICRI CSP Standards for acceptable profile height). Thoroughly wash/rinse with clean potable water. Surface defects or holes in the substrate must be patched per manufacturer’s recommendations.

B. Slurry Bond Coat

1. Horizontal surfaces to receive a thick bed mortar application must be installed over a slurry bond coat of either LATICRETE 254 Platinum one-step, polymer-fortified, thin-set mortar or MAPEI Planislope RS polymer-modified pre-blended, rapid-setting mortar mixed with water only in compliance with ANSI A108.1A (2.2 & 5.2). As manufactured by LATICRETE International, MAPEI, Inc., or approved equal. Note that slurry bond coats are not required under vertical applications of the render and scratch coat.

C. Mortar & Leveling Beds

1. Bonded Thick Bed Method (Floor / Horizontal Surfaces): Provide a dry pack, thick mortar bed on horizontal surfaces consisting of LATICRETE 3701 Fortified Mortar Bed or MAPEI Planislope RS polymer-modified pre-blended, rapid-setting mortar mixed with water only. Apply over a properly prepared slurry bond coat.

2. Render- Scratch and Float Coats (Wall / Vertical Surfaces): Provide wall render (scratch and float coats) on vertical competition turning surfaces to a depth of 4'-0" below the water surface, consisting of either LATICRETE 3701 Fortified Mortar Bed or LATICRETE 3701 Lite Mortar or MAPEI Planislope RS polymer-modified pre-blended, rapid-setting mortar mixed with water only for lift thicknesses up to ½". Wall render is made to a plastic consistency when used vertically. Fill holes and bring surface up to line and plane as required. As manufactured by LATICRETE International, MAPEI, Inc. or approved equal. Note that slurry bond coats are not required under vertical applications of the render and scratch coat. (Refer to Course Length Tolerances for competitive pools.)

D. Tile Thin-Set
1. Use either LATICRETE 254 Platinum one-step, polymer fortified, thin-set mortar or MAPEI Keraflex Super one-step, polymer modified, thin-set mortar, used in accordance with the manufacturer's requirements. As manufactured by LATICRETE International, MAPEI, Inc., or approved equal.

E. Tile Grout
1. Use either LATICRETE SPECTRALOCK PRO Premium Grout or MAPEI Kerapoxy CQ Grout in accordance with the manufacturer's requirements as manufactured by LATICRETE International, MAPEI, Inc. or approved equal. Color selection by Owner/Architect.

F. Elastomeric Sealant
1. Use LATICRETE LATASIL over LATASIL 9118 primer or MAPEI Mapesil "T" 100% silicone sealant for inside/outside corners, expansion/movement joints, and to seal lighting/plumbing fixture penetrations. The primer and sealant installation must be in accordance with the manufacturer's requirements. As manufactured by LATICRETE International, Inc., MAPEI, Inc. or approved equal. Color selection by Owner/Architect.

G. Mixing and application procedures must be in accordance with the manufacturer's recommendations and requirements. The manufacturer's representative must visit the site to verify field conditions, confirm materials and application requirements and ascertain that materials and systems are so installed. Documentation must be provided to this effect.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete water tightness test prior to tile installation. The concrete tank must be watertight per ASTM D5957, the Tile Council of North America, and specification 13 11 00.

B. Clean substrates of dust, dirt, oil, grease, curing compounds and other foreign substances and mechanically roughen concrete and shotcrete for bond. Conform to applicable reference standards and to recommendations of manufacturers of materials used and meeting ICRI, CSP of 3-5.

C. Substrates to Receive Mortar Setting Beds
1. Dampen concrete substrate to receive tile work according to above referenced standards or tile manufacturer's instructions, as required.

D. Substrates to receive thin set tile applications must meet normal construction tolerances of 1/4" in 10' where competition tolerances do not apply and must meet competition tolerances

where required elsewhere in these specifications, and must be free of bumps, dips and surface irregularities that may affect the satisfactory installation of the tile.

E. Tile Wetting
   1. Dampen tile according to above reference standards or tile manufacturer's instructions, as required.

F. Screeds
   1. Accurately set temporary screeds to control the finish plane of mortar-bed set tile and remove as soon as setting bed is sufficiently hardened. Fill void spaces from screeds with same mortar.

3.2 TILE INSTALLATION

A. Arrange tile according to patterns detailed. Set tile with flush well-fitted joints, finished in true planes, plumb, square, joints of uniform size. Provide approved trimmers as shown or required. Cut tile without marring. Carefully grind and joint tile edges and cuts.

B. Follow Tile Council of North America installation methods P601 and B417 to achieve total tile system thickness for thin or thick set.
   1. Thick Set
      a. Apply specified setting bed mortar, up to 2” in thickness, on cured and dried concrete pool shell. Tamp and screed to required planes. Spread no more mortar than can be covered with tile before initial set. Do not use re-tempered mortar. Trowel 3/32” to 1/8” thick bond coat over plastic setting bed mortar just before setting tile or apply bond coat to back of each tile placed. Set tile in position and beat firmly into the setting bed mortar. Bring tile faces to a true and correct plane. Complete beating and leveling before mortar sets and in no case later than one hour after first placing. When ready, wet and remove paper and glue avoiding excess water. At this time adjust out-of-line or out-of-level tile.
   2. Thin Set
      a. Apply specified bond coat on cured and dried concrete pool shell. Trowel 3/32” to 1/8” thick bond coat over concrete pool shell just before setting tile or apply bond coat to back of each tile placed. Set tile in position and beat firmly into the setting bed mortar. Bring tile faces to a true and correct plane. Complete beating and leveling before mortar sets and in no case later than one hour after first placing. When ready, wet and remove paper and glue avoiding excess water. At this time adjust out-of-line or out-of-level tile.

C. Finished tile surface must be level and in plane, with no sharp or protruding edges. Tiles out or plane more than 1/16" must be removed and replaced. Sharp edges must be stoned smooth.

D. Grout Joint Sizes
   1. Unless otherwise approved, install tile with uniform 3/32” joint width. A maximum 1/8" joint width may be utilized to meet specific installation requirements, if required.

E. Ceramic Tile Joint Grouting
   1. Mix grout to a thick creamy consistency and force into joints for entire thick depth, flush with surface. Clean off excess and fill skips and gaps before grout sets. Color selection by Owner/Architect or Interior Designer. Provide dampness for minimum 3-day curing and polish with clean dry cloths (not required when epoxy grouts are used).

F. Expansion Joints

1. Place expansion joint per applicable TCNA Method P601MB, P601TB, or P602 and conforming to Method EJ171. Provide shop drawings showing backer rod and joint dimensions. Expansion, control, construction, cold, and seismic joints in the pool structure should continue through the tile work, including such joints at vertical surfaces. Movement joints must be placed at changes in direction and elevation. Refer to the structural engineer for additional required movement joints. Joint size must be a minimum of 1/8". Joints through tile work directly over structural joints must not be narrower than the structural joint. The Contractor must use cement compatible coatings when using chalk lines for joint layout purposes.

G. Fill and Empty Rates
1. Use a fill and drain rate of 2'-0" per 24 hours to minimize thermal shock and structural movement. Maintain a temperature differential of 10 degrees Fahrenheit or less between the pool water and the substrate during fill and drain cycles.

3.3 TESTING AND INSPECTION

A. Before filling of the pool, and its subsequent provisional acceptance at substantial completion, the tile installation must be visually inspected and sounded in the presence of the Architects and/or the Owner's representative to verify mortar coverage below the tile to its substrate as well as its overall compliance with the requirements of this Section.

B. Tile work found loose, lacking proper mortar coverage, out of plane, misaligned or otherwise non-conforming must be removed and replaced at no additional cost to the Owner.

3.4 CLEANING

A. Upon completion of placement and grouting, clean tile installation as recommended by TCNA and manufacturers of proprietary materials. Tile must be cleaned with pH neutral solutions, free of both sodium and potassium, in accordance with the tile and grout manufacturer's printed instruction.

B. Leave finished installation clean and free of cracked, chipped, broken, un-bonded or otherwise defective tile work.

C. Protect installed tile work with non-staining Kraft paper, polyethylene sheeting, or other approved heavy covering during the construction period to prevent damage.

3.5 REPLACEMENT TILE

A. Provide the Owner with approximately 10% or 25 square feet (whichever is least) of each color and type tile used on the project for Owner's repair and replacement requirements.

END OF SECTION 13 11 03

SECTION 13 11 04 - SWIMMING POOL CEMENTITIOUS FINISH

PART 1 GENERAL

1.1 SUMMARY

A. Provide a proprietary aggregate plaster finish, Diamond Brite, Pebble Sheen to the pool structure(s). Provide installation of bond coat prior to application of pool finishes in strict accordance with manufacturer's instructions. Provide ceramic tile trim on the pool perimeter tile band, vertical tile band, floor, walls, stairs, nosings, recessed wall steps, toe ledge, depth markings, wall targets, floor lane markings and other tile installations as shown and detailed on the contract drawings and in strict accordance with these specifications.

B. The spa has a tile finish. Refer to the Swimming Pool Tile, 13 11 03 specification.

C. Provide water analysis and pre-fill requirements.

1.2 SUBMITTALS

A. Color Samples
   1. Provide physical color samples for review and approval by the Owner/Architect.

B. Mockup
   1. Prepare 12-inch square panel at the site showing color and texture for pool plaster for approval by the Owner/Architect. Finished cementitious finish work must match the approved sample panel.

C. Test Report
   1. Submit results of domestic water analysis and calculation of amounts of chemicals required to balance pool water on initial fill of pool.

1.3 PRODUCT DELIVERY AND STORAGE

A. Deliver manufactured materials to site in manufacturers' original unbroken packages or containers bearing manufacturers' name and brand labels. Keep cementitious materials dry until ready to be used and stored off the ground, under cover and away from damp surfaces.

1.4 JOB CONDITIONS

A. Apply plaster in swimming pool only when ambient temperature is above 40 degrees F and below 90 degrees F and protect applied plaster from rapid drying by sun or wind until curing is completed or pool is filled with water. Confirm and comply with applicable manufacturer's installation requirements.

1.5 QUALITY ASSURANCE

A. The Contractor must have two years' experience in similar pool projects, for which the Owner may require written proof thereof and proper tools to install plaster.

PART 2 PRODUCTS

2.1 DIAMOND BRITE

A. The Contractor must provide a slip-resistant proprietary plaster finish in the areas indicated on the drawings. Description: Diamond Brite finish must be a blend of selected quartz aggregates and fortified white Portland cement. Color and texture selected by the Owner/Architect. Confirm installation requirements with the manufacturer.

B. Surface Preparation
   1. Surface must be structurally sound and free of foreign substances and debris that could reduce or impair adhesion, free of dirt, oil, grease, curing compounds or other foreign materials. Sound and remove loose concrete to firm substrate. Surfaces must be roughened by sand blasting or water blasting. Shot blasting, scarifying, or grinding can also be accepted methods of surface preparation. Pressure-wash the entire surface. Wash with trisodium phosphate (TSP) using a stiff broom. Thoroughly wash/rinse with clean potable water. Surface defects or holes in the substrate must be patched per manufacturer's recommendations. Lightly moisten walls and floors prior to application of Diamond Brite.

C. Bond Coat
   1. Bond Kote by SGM, Inc., or approved equal, in strict accordance with manufacturer's instructions. Apply and cure bond coat per manufacturer's recommendations. After proper curing of bond coat, lightly moisten with clean potable water prior to application of cementitious finish. Ensure bond coat is free of foreign matter prior to plastering.
   2. A bond coat must be installed over all interior pool surfaces prior to plaster application unless the surface profile is adequate to omit the bond coat in accordance with the manufacturer's recommendations. A manufacturer's representative must visit the site and provide written confirmation that the bond coat can be omitted, and all warranties will be maintained.

D. Mixing
   1. Thoroughly mix Diamond Brite to a homogeneous lump-free consistency using 1-1/2 to 2 gallons of potable water per 80 lb. bag.

E. Application
   1. Diamond Brite must be applied to a uniform thickness of 3/8" to 1/2" over the entire surface. The walls must be scratch coated followed by a finish coat. Material applied to the floor after the walls have been applied must be accelerated to assure uniform setting time throughout the pool surface.

F. Coverage
   1. Each 80 lb. bag to cover approximately 25 square feet to a thickness of 3/8".

G. The proprietary plaster finish must be applied by a licensed applicator as approved by the manufacturer.

2.2 PEBBLE SHEEN

A. The Contractor must provide a slip-resistant pebble stone surface in the areas as indicated on the drawings. Description: Pebble Sheen finish must be a blend of selected colored aggregates and fortified white Portland cement. Color and texture selected by the Owner/Architect. Finish to consist of Pebble Sheen as supplied by Pebble Technology, Inc. (480) 948-5058, or approved equal. Confirm installation requirements with the manufacturer.

B. Surface Preparation
   1. Surface must be structurally sound and free of foreign substances and debris that could reduce or impair adhesion, free of dirt, oil, grease, curing compounds or other

foreign materials. Sound and remove loose concrete to firm substrate. Surfaces must be roughened by sand blasting or water blasting. Shot blasting, scarifying, or grinding can also be accepted methods of surface preparation. Pressure-wash the entire surface. Wash with trisodium phosphate (TSP) using a stiff broom. Thoroughly wash/rinse with clean potable water. Surface defects or holes in the substrate must be patched per manufacturer's recommendations. Lightly moisten walls and floors prior to application of Pebble Sheen.

C. Bond Coat
   1. Scratch Kote System by Multicoat Corporation, Bond Kote by SGM, Inc., or approved equal, in strict accordance with manufacturer's instructions. Apply and cure bond coat per manufacturer's recommendations. After proper curing of bond coat, lightly moisten with clean potable water prior to application of cementitious finish. Ensure bond coat is free of foreign matter prior to plastering.
   2. A bond coat must be installed over all interior pool surfaces prior to plaster application unless the surface profile is adequate to omit the bond coat in accordance with the manufacturer's recommendations. A manufacturer's representative must visit the site and provide written confirmation that the bond coat can be omitted, and all warranties will be maintained.

D. The cement-pebble stone mixture must be pneumatically applied to the pool surface.

E. After application of Pebble Sheen material the surface must be hand troweled for exposure of pebble material.

F. Spray down the troweled surface with water to remove excess cement and exposure of pebbles.

G. Surface is allowed a minimum of a 24-hour hardening period. Upon hardening the surface is cleansed with an approved solution as provided by the manufacturer for final exposure and luster of pebble surface.

H. Surface must be buffed so as to ensure sharp edges are removed and final surface texture is per the manufacturer's recommendations.

I. Natural pebble stone surface must be applied by a licensed applicator as approved by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES AND BOND COAT

A. Surface must be structurally sound and free of foreign substances and debris that could reduce or impair adhesion, free of dirt, oil, grease, curing compounds or other foreign materials. Sound and remove loose concrete to firm substrate. Surfaces must be roughened by sand blasting or water blasting. Shot blasting, scarifying, or grinding can also be accepted methods of surface preparation. Pressure-wash the entire surface. Wash with trisodium phosphate (TSP) using a stiff broom. Thoroughly wash/rinse with clean potable water. Surface defects or holes in the substrate must be patched per manufacturer's recommendations.
   1. National Plasterers Council Surface Preparation Definitions
      a. Pressure Washing: The washing or cleaning of a surface by a stream of water ejected from a nozzle at high velocity, typically in the range of 1,000 psi – 4,000 psi.

b. Water Blasting: The cutting, abrading, or removal of a surface or substrate by a stream of water ejected from a nozzle at ultra-high velocity, typically in the range of 10,000 psi – 40,000 psi.

2. Apply and cure bond coat in strict accordance with manufacturer's instructions. After proper curing of bond coat, lightly moisten with clean potable water prior to application of cementitious finish. Ensure bond coat is free of foreign matter prior to plastering.

B. Do not apply finish materials to base surfaces containing frost. Provide temporary coverings as required to protect adjoining surfaces from staining or damage by plastering operations.

C. Protect or mask adjacent surfaces that are not scheduled to receive cementitious finish. If expansion or construction joints exist in the areas where cementitious finish will be applied cover plastic joints for protection (if plastic joints are used). Additionally, mark joints for saw-cutting if area will be saw-cut.

D. Verify that concrete surfaces that are to receive a cementitious finish have cured for a minimum of 5 days. Consideration should be given for the application of a primer for concrete structures that is over 28 days old to improve bonding.

3.2 APPLICATION OF CEMENTITIOUS FINISH

A. General

1. Confirm application requirements with the manufacturer. Apply finish plaster to the properly prepared substrate at the minimum thickness required by the manufacturer, but no less than 3/8-inch thickness. Apply finish plaster by hand or machine. If plastering machine is used, control fluidity of plaster to have a slump not exceeding 2-1/2 inches when tested using a 2" by 4" by 6" high slump cone. Do not add additional water to the mix subsequent to determining water content to meet this slump. Perform slump test according to following procedure:
   a. Place cone on level, dry non-absorptive base plate.
   b. While holding cone firmly against base plate, fill cone with plaster taken directly from hose or nozzle of plastering machine, tamping with a metal rod during filling to release air bubbles.
   c. Screed off plaster level with top of cone. Remove cone by lifting it straight up with a slow and smooth motion.
   d. Place cone in a vertical position adjacent to freed plaster sample suing care not to jiggle base plate.
   e. Lay straightedge across top of cone being careful not to vibrate cone, measure slump in inches from bottom edge of straightedge to the top of slumped plaster sample.
2. Mixing of materials and application procedures must be done in accordance with the manufacturer's recommendations and requirements. The manufacturer's representative must visit the site to verify field conditions, confirm materials and application requirements and ascertain that materials and systems are so installed. Documentation must be provided to this effect.

B. Workmanship

1. Unless otherwise required by the manufacturer, apply finish plaster in two coats by "double-back" method with second coat applied as soon as first coat is tamped and initially floated. Apply plaster with sufficient pressure to provide a good bond on bases. Work plaster to screeds at intervals of from 5 feet to 8 feet on straight surfaces. Apply smooth trowel finish without waves, cracks, trowel marks, ridges, pits, crazing, discoloration, projections, or other imperfections. Form plaster carefully

around curves and angles, well up to screeds. Take special care to prevent sagging and consequent drooping of applications. Produce surfaces free of visible junction marks in finish coat where one day's work adjoins another. Finish proprietary plaster as required by the manufacturer.

2. Cementitious finishes must be applied by a licensed applicator as approved by the manufacturer.

C. Curing

1. Curing cementitious finishes with fine fog water spray applied to finish coat as frequently as required to prevent dry-out of surface, or as directed by the manufacturer of the cementitious finish. Keep plaster damp until the pool is filled. Prevent damage or staining of plaster by troweling or curing.

D. Patching, Pointing, and Cleaning Up

1. Upon completion, cut out and patch loose, cracked, damaged, or defective plaster; patches matching existing plaster in texture, color, and finish, flush with adjoining plaster. Perform pointing and patching of surfaces and plasterwork abutting or adjoining other finish work in a neat and workmanlike manner. If 10 percent or more of the pools plaster finish is found to be defective, the plaster must be removed and replaced complete from surfaces. Remove plaster droppings or spattering from surfaces. Leave plaster surfaces in clean, unblemished condition ready for pool filling. Remove protective coverings from adjoining surfaces. Remove rubbish and debris from the site.

3.3 PRE-FILL SPECIFICATION

A. Contractor must employ a qualified water testing agency to analyze the domestic water with which the pool will be filled within 2 weeks of the plaster date and must employ a swimming pool experienced water chemistry consultant to determine types and quantities of chemicals required to ensure calcium-balanced water immediately upon the completion of water filling. Refer to Section 13 11 00 for water filling requirements.

1. Have on hand quantities of the chemicals as determine above, plus 25% overage for follow-up treatment. These chemicals, typically including calcium chloride, bicarbonate of soda, and muriatic acid are in addition to standard bromine/chlorine products and alkalizer/pH control products required elsewhere.

B. The pool(s) must not be plastered until directed by the Owner’s representative and the filtration system and chlorination system are complete and ready for start-up. The Contractor must supply chemicals required for treatment of the pool water.

C. The Contractor must submit domestic water analysis to the Owner and/or Architect at least 2 weeks prior to filling the pool(s).

END OF SECTION 13 11 04

SECTION 13 11 06 - SWIMMING POOL TIMING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Provide a proprietary aggregate plaster finish, Diamond Brite, Pebble Sheen to the pool structure(s). Provide installation of bond coat prior to application of pool finishes in strict accordance with manufacturer's instructions. Provide ceramic tile trim on the pool perimeter tile band, vertical tile band, floor, walls, stairs, nosings, recessed wall steps, toe ledge, depth markings, wall targets, floor lane markings and other tile installations as shown and detailed on the contract drawings and in strict accordance with these specifications.

PART 2 GENERAL

2.1 RELATED DOCUMENTS

A. The BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in the Table of Contents, must be included in, and made a part of, this Section.

2.2 SUMMARY OF WORK

A. Introduction
   1. Provide labor, materials, equipment, and services necessary to provide an electronic timing and scoreboard system with multi-sport capability for race swimming and pace clock.

B. Work included in this section.
   1. It is the intent of this section to place the entire responsibility for the electronic timing and scoreboard system (including appropriate connections) with multi-sport capability under one vested supplier. The supplier is responsible for providing full integration of this system. Multiple suppliers for a system will not be approved.

C. Related work specified in Electrical sections. Reference Division 26 – Electrical.
   1. Ground and bond pool structures, fittings, and equipment in accordance with Article 680 of the N.E.C. Test and verify that the system electrical ground is true and solid. Provide certification for this effort.
   2. Obtain permits, inspections, and approvals of wiring including grounding and bonding of metal components associated with the pool in accordance with Local, State and National Electrical Codes.
   3. Provide power, conduits, electrical boxes, ethernet connections and wiring for the Contractor provided electronic timing and scoreboard system with multi-sport capability for race swimming and pace clock.
   4. Supply junction boxes for equipment outlined in these specifications and depicted on the timing system drawings.

D. Basis of Design:
   1. The complete electronic timing and scoreboard system with multi-sport capability is based upon Colorado Timing Systems, Inc.

2.3 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

A. Colorado Time Systems, Inc. (Basis of Design: Timing System & Scoreboard)

2.4 SUBMITTALS

A. Submittals must include the following:
   1. Product data
   2. Shop drawings detailing system layout.
   3. Operations and maintenance manuals for the systems. Manuals must include a complete parts list.
   4. Warranty for each piece of equipment within this section.

2.5 JOB CONDITIONS

A. Manufacturers proposing to submit a quotation for the electronic timing and scoreboard system must confirm that embedded items are compatible with the installation of their respective systems.

B. Manufacturers must review the construction documents and must notify the architect 10 days prior to the bid date of conflicts or additions to the work of other trades for the proper installation of their system.

2.6 WARRANTIES

A. The Contractor must warranty the completed installation of systems in this section for one year.

B. The manufacturer must provide a warranty for the computer consoles, pace clocks and starting system for two (2) years.

C. The manufacturer must provide a warranty for the touchpads for three (3) years.

D. The manufacturer must provide a warranty for the titanium timing system wall plate and deck plates for five (5) years.

E. The manufacturer must provide a warranty for the scoreboard for five (5) years.

PART 3 PRODUCTS

3.1 SCOREBOARD SYSTEM

A. Multi-Sport LED Numeric Scoreboard System
   1. The multi-sport LED Scoreboard system must display necessary information to time swimming in compliance with the appropriate sanctioning body - USA SWIMMING and NFHS.
      a. Basis of Design: Multi-Sport LED Scoreboard System is based upon Colorado Timing Systems, Inc. or approved equal.
   2. Each line of scoreboard must use seven segments 10” high LED digits choosing red or amber color.
   3. Each line of scoreboard must have an internal data selector switch to permit owner/operator selection of data codes that must be installed at each line of scoreboard. Data select codes may be manually changed at the scoreboard or logically changed from the timer console. Scoreboards with fixed function displays are unacceptable.

4. Each line of scoreboard can have up to eight operable digits, eight operable decimals, and one operable colon to provide maximum display flexibility and reduced cost. Scoreboards with fixed decimals and colons are unacceptable.
5. Each line of scoreboard must have an individual internal power supply and individual control circuit to limit loss of data to one line if a malfunction should occur or to permit its use as an independent line of scoreboard.
6. Each line of scoreboard must have true multi-sport capability through the use of sliding digits to permit reformatting to desired configurations. Digits must move freely without the use of hand tools.
7. Each line of scoreboard must be constructed identically (modular) to permit on-site substitution or replacement of failed unit.
8. The scoreboard must be capable of being used in a time-of-day mode when not being used in display modes.
9. Power must be 115VAC, 2 amp, 250 watts per module maximum.
10. Scoreboard must be constructed for indoor installation. Facility name panel must be provided with artwork provided by the Owner/Architect. Contractor to coordinate artwork for facility name panels with Owner/Architect and submit mockups as required.
11. The scoreboard must display the following minimum requirements:

1-6 Lines	Lane Place and Time 8-Digit Display
1 Line	Sponsor/Facility Name
1 Line	Event and Heat
2 Lines	Lane Place and Time Sign

B. Scoreboard Hanging Requirements
   1. The scoreboard manufacturer must provide drawings with hanging information.
      a. Material: Scoreboard hangers must be galvanized steel for an indoor natatorium.
      b. Coordinate scoreboard hanging requirements with structural engineer prior to the submittal process.
   2. Anchors
      a. Hollow Block Construction
         1) Sleeve type anchors feature a split expansion sleeve over a threaded stud bolt body and integral expander, nut, and washer. Anchors must be made of zinc plated Carbon Steel, or Type 18-8 Stainless Steel. Anchors should be installed with carbide tipped hammer drill bits made in accordance with ANSI B212.15-1994. Anchors must be tested to ASTM E488 criteria and must meet or exceed U.S. Government G.S.A. specification A-A-55614 Type 2 (Formerly GSA: FF-S-325 Group VIII, Type 2), California State Fire Marshal, Factory Mutual and Underwriters Laboratories.
      b. Filled Block or Solid Concrete Construction:
         1) The anchor must be a torque-controlled expansion anchor, which provides consistent performance for a wide range of mechanical anchor applications. This anchor series is available in carbon steel with zinc electroplated coating, carbon steel with hot-dip galvanized coating, 304 stainless steel and 316 stainless steel versions. The threaded stud version of the anchor is available in a variety of diameters ranging from 1/4- to 1-in. depending on the steel and coating type. Applicable base materials include normal-weight concrete, structural lightweight concrete, lightweight concrete over metal deck, and grout-filled concrete masonry.

Basis of design is AISI Type 316 stainless steel KWIK Bolt 3 (KB3) manufactured by Hilti, Inc.

2) Three anchors must have an anchor body, nut and washer that conform to AISI Type 316. The expansion wedges conform to AISI Type 316 stainless steel.

3) Anchor bodies smaller than 3/4-inch, excluding KWIK Bolt 3 Countersunk, are produced from AISI Type 304 or Type 316 stainless steel having the bolt fracture loads shown in table 1. Anchor bodies 3/4-inch and larger, and stainless-steel KWIK Bolt 3 Countersunk anchor bodies are produced from AISI Type 304 or Type 316 stainless steel having the mechanical properties shown in table 1. Nuts meet the dimensional requirements of ASTM F594. Washers meet the dimensional requirements of ANSI B18.22.1, Type A, plain. Stainless steel expansion wedges for AISI Type 304 are made from either AISI Type 304 or Type 316. Stainless steel expansion wedges for AISI Type 316 anchors are made from type 316. Stainless-steel nuts and washers for AISI Type 304 or Type 316 anchors are manufactured from AISI Type 304 or 316, respectively.

3. Supports
   a. Unistrut (LED Numeric Board)
      1) Material
         a) Unistrut channels are accurately and carefully cold formed to size from low-carbon strip steel. Spot-welded combination members, except P1001T, are welded 3" (76 mm) maximum on center.
      2) Finishes
         a) Channels are available in Perma Green III (GR), Pre-galvanized (PG) conforming to ASTM A653 G90, Hot-dipped galvanized (HG) conforming to ASTM A123.
4. Brackets
   a. Per ANSI B1.1- Surface roughness per ANSI B46.1- Surface roughness on holes 250 MAX unless otherwise specified. Variations in form from unmachined features are permitted within established –l filets 0.005-0.020 (APPROX. RADIUS) – Screw threads per ANSI B1.1- Pipe threads commercial standards. Edges and corners 0.005-0.020 (approx. radius or chamfer).
   b. Materials and components used in the assembly of this item must be RoHS complaint material: 12GA (.105) HRS. The finish must be ZINC CLEAR CHROMATE PLATED. Manufacturer must break sharp edges and corners.
   c. Support hardware, brackets, fasteners, hangers, etc. used during installation of the scoreboard must be Zinc Clear Chromated Plated.

3.2 MULTI-SPORT COMPUTER/TIMING SYSTEM

A. Gen 7 Serial Timing System
   1. The Swim Timing System must be supplied with the necessary software to time swimming in compliance with the appropriate sanctioning body - USA SWIMMING and NFHS.
      a. Basis of Design: The Swim Timing System is based upon the GEN7 TIMING as manufactured by Colorado Timing Systems, Inc.
   2. The Swim Timing System must be a standalone unit with physical connections to timing inputs. Timer must be controlled by user interface device (e.g., computer, tablet, etc.) via network. One (1) laptop must be provided.

a. A timer PC or tablet interface device must be supplied with necessary software to time and score swimming in compliance with the appropriate governing organization(s) - USA SWIMMING and NFHS.
b. Configuration of racecourses must be through graphical user interface. It is unacceptable that race configurations need specific cable connections to system connections such as wall plates defining a specific end of a course.
c. The user interface must display complete race status. The interface must be capable of functioning as miniature scoreboard displaying information simultaneously for active lanes including lane number, current length in race or final place, split or finish time, relay judging status indicator, and backup time and backup button status.
d. Timer must automatically flag timing discrepancies (in the user interface, on the results printouts and in stored memory) greater than a user defined interval between touch pad and backup times.

3. Multi-Sport Computer/Timing System input/output ports must include:
   a. Must accept inputs for up to 4 courses of up to 20 lanes each for a serial in-deck wiring installation and must be able to time them simultaneously.
   b. Must accept on-deck cable harness inputs for up to 20 lanes near end and/or far end.
   c. Must communicate with meet management peripheral software on a two-way “handshake” basis, enabling the meet manager’s resident computer to query the timer’s memory via the USB port or via the network at any time for any race results.
   d. Must provide backup time via push button provided on a per lane basis should swimmer fail to trigger touch pad or touch pad fail to register. The timer must be capable of accepting up to three backup button times per lane.
   e. Must automatically compare the touch pad hit of an incoming swimmer with the starting swimmer’s time of departure from the optional relay-judging platform. Results display both “plus” and “minus” takeoff times and can be printed and stored in race memory.
4. Accuracy of the Multi-Sport Computer/Timing System:
   a. Must time to a user-selectable resolution from 1 second to .001 second. It must take starts and finishes from the near end and/or far end of the pool. It must accept inputs from the start system; touch pads, up to three manual button backup times per lane, and relay judging platforms.
   b. Must be able to evaluate and report multiple states of timing component input condition, ranging from excellent to failure. It is unacceptable that only two states such as on or off are reported.
   c. Must have touch pad delay feature with ability to program delays from 1 to 99 seconds.
   d. Must permit the operator to correct for an erroneous touch by adding/subtracting a touch pad hit to correct the lengths completed. The interface must not permit the operator to finish a race in any lane; timers including such a function are unacceptable because they permit the possibility of cheating.
   e. Later recall of stored race data must allow for a re-run of a given race including changes in user decisions.
5. Multi-Sport Computer/Timing System Detection:
   a. Must be capable of detecting timing components such as pushbuttons, touchpads, RJPs, speakers, Speedlight and start systems connected to an in-

deck system and capable of detecting touchpads and RJPs connected to an on-deck system.

b. Must be capable of reporting corrosion in the in-deck wiring installation.

6. Multi-Sport Computer/Timing System must run off a 12-volt power supply connected to a standard 110/240 VAC outlet and will automatically switch to (and display on screen of connected interface device) internal battery power source, in case of line power failure without affecting the continuity and accuracy of the timing system.
7. Multi-Sport Computer/Timing System must interface to single-line and multi-line scoreboard and must post immediate results to scoreboard in “Lane” or “Place” order (user selectable). The timer must also have the capability to pull race results from memory and post those results to the scoreboard in “Lane” or “Place” order (user selectable).
8. Multi-Sport Computer/Timing System must include an internal clock calendar with self-sustaining battery to time/date stamp results.
9. Multi-Sport Computer/Timing System must meet acceptable safety standards. Must be UL approved, or equivalent.
10. Multi-Sport Computer/Timing System Storage and Internal Memory:
    a. System must store each and every timing input state change. It is not acceptable that state changes get discarded and are not available for later re-evaluation of a race.
    b. Race data, including near and far end splits, must be stored to internal memory for later recall to facilitate meet management connectivity and printing. Printed reports must include cumulative and subtractive splits as well as relay judging times (when required).
    c. Meet memory must be capable of being transferred to external storage (via USB) or cloud data backup services (e.g., Dropbox, Google Drive).
11. Multi-Sport Computer/Timing System must have an Automatic Event Sequencer that is capable of holding both standard and user defined event sequences. The event order will be able to be downloaded from meet management software. The desired order is user selectable. EVENT SEQUENCES with appropriate race distance and race description for high school, college meets, and two “User Defined” meets to permit construction of custom meets, USA SWIMMING and NFHS. When recalled from memory, race distance and descriptions are automatically selected for the operator.
12. Multi-Sport Computer/Timing System must have user interface software that permits operation of essential functions including Lane Off/On, Finish Arm, Split Arm, & Print Results directly from the main screen to ensure speed and simplicity of operation during critical race times. The interface must permit the operator to edit a time when required or to disqualify a lane (DQ), automatically posting it to the scoreboard, and provide automatic re-ranking of results. Corrections generated by the operator (edit or disqualification) must be clearly identified on the results printouts.
13. Multi-Sport Computer/Timing System must include electronic beeper and LED signaling to indicate touchpad, backup button and RJP inputs. Timers which do not allow the user to configure (enable/disable) this feature are unacceptable.
14. Multi-Sport Computer/Timing System connectivity must include:
    a. USB (Type A) port for external storage
    b. USB (Type B) port for meet management connectivity.
    c. USB (Type B) port for user interface computer connectivity
    d. Ethernet port for network connectivity
    e. 3 independent scoreboard output ports
    f. Wireless 2.4GHz scoreboard connectivity

g. Connection for in-deck wiring and two connections for on-deck (near and far end) wiring.
h. Start system connection directly to timer.
i. External DC power port

15. Multi-Sport Computer/Timing System must be capable of updating internal software/firmware via Internet connection.
16. Multi-Sport Computer/Timing System software must have the ability to adjust the intensity of LED scoreboard brightness.
17. Cabling, conduit, and wiring must be provided by the manufacturer of the Multi-Sport Computer/Timing System to connect the Multi-Sport Computer/Timing System to the scoreboard should the scoreboard be provided by an alternative manufacturer to the Multi-Sport Computer/Timing System.

3.3 SWIMMING TIMING SYSTEM CONNECTORS

A. General Description
1. The Multi-Sport Computer/Timing System must employ the topology of a single communication bus to which timing and connectivity nodes are connected and communicate with each other.
2. Connection points must be production items and not a one off or prototypes.
3. Exposed connectors must feature titanium contacts. They must be wet pluggable and electrically passive if not connected. No maintenance to prevent corrosion of deck plate connector contacts is needed.
4. Self-test capabilities to detect compromised timing bus wire terminations and scoreboard bus wire terminations.

B. Wall Plates
1. Wall plates must be provided as required in the quantities as shown on the drawings. Wall plates must be the termination point for connections between deck cables, timers, start system, and other wall plates.
a. Basis of Design: Wall plates are based upon TITANIUM SERIAL WALL PLATE as manufactured by Colorado Timing Systems, Inc.
2. Wall plates must allow for the following connections depending on location and usage:
a. Connection to the timer.
1) Connectivity to timing courses and one scoreboard bus with one cable connection.
2) Detection of presence or absence of connected timer.
3) Diagnostic capabilities to detect anomalies with connectors (corrosion, shorts).
b. Connection to a start system and must provide the following:
1) Inputs for start system and speaker.
2) Diagnostic capabilities to detect anomalies with connectors (corrosion, shorts) and anomalies with the speaker input or start system.
3) Detection of presence or absence of speaker input or start system.
c. Connection to a scoreboard and must provide the following:
1) Detection of presence or absence of connected scoreboard.
2) Self-test capabilities to detect compromised timing bus wire terminations.
3. Junction Boxes (Provided by Electrical):
a. Wall plate components must fit into a 12” x 12” x 6” PVC junction box.
b. Acceptable Manufacturer: Cantex (P/N 5133713) or similar box that will fit wall plate assembly of the following dimensions: 12” x 12” x 6” +-0.05”, cover plate width must be 15” +-0.02” square.

c. Conduit interconnects between boxes (deck plates and wall plates) must be PVC. Refer to drawings for sizing.
d. Verify routing of conduit with Multi-Sport Computer/Timing System manufacturer prior to installation.

C. Deck Plates
1. Deck plates must be provided as required in the quantities as shown on the drawings. Deck plates to permit plug-in connection for touch pads, A, B, C, backup buttons, electronic relay judging, start light signal, start speakers and a signal to start the timing device at each lane.
a. Basis of Design: Deck plates are based upon TITANIUM SERIAL DECK PLATE as manufactured by Colorado Timing Systems, Inc.
2. Domed deck plate node with contacts mounted on integrated slopes that cause corrosive pool water which creates water bridges to flow off through gravity, overcoming water surface tension and therefore reducing electrolytic currents and corrosion. No maintenance for corrosion is needed.
3. Titanium contacts as exposed connectors.
4. Inputs for button A, B, C, touchpad, start system, speaker, RJP and Speedlight (RJP as separate input, not piggy backed on another input).
5. Speedlight must be controlled in synchronicity and individually per lane (requires RJPs).
6. Diagnostic capabilities to detect anomalies with connectors (corrosion, shorts) and anomalies with the timing components push buttons, touchpad, RJP, Speedlight, speaker or start system.
7. Ability to detect presence or absence of push buttons, touchpad, RJP, Speedlight, speaker or start system.
8. Plate must have self-test capabilities to detect compromised timing bus wire terminations.
9. Junction Boxes (Provided by Electrical):
a. In deck system components must fit into a 4” x 4” x 6” PVC junction box (Carlon Model #E989NNR-CAR).
b. Conduit interconnects between boxes (deck plates and wall plates) must be PVC. Refer to drawings for sizing.
c. Verify routing of conduit with Multi-Sport Computer/Timing System manufacturer prior to installation.

D. Start System Deck Plate
1. Start system deck plates must be provided as required in the quantities as shown on the drawings.
a. Basis of Design: Start system deck plates are based upon TITANIUM SERIAL START SYSTEM DECK PLATE as manufactured by Colorado Timing Systems, Inc.
2. Connection to start system that must provide the following:
a. Inputs/outputs for start system and speaker.
b. Detection of presence or absence of speaker input or start system.
c. Diagnostic capabilities to detect anomalies with connectors (corrosion, shorts) and anomalies with the speaker or start system.
3. Junction Boxes (Provided by Electrical):
a. In deck system components must fit into a 4” x 4” x 6” PVC junction box.
b. Conduit interconnects between boxes (deck plates and wall plates) must be PVC. Refer to drawings for sizing.

c. Verify routing of conduit with Multi-Sport Computer/Timing System manufacturer prior to installation.

E. Timer Deck Plate
1. Timer deck plates must be provided as required in the quantities as shown on the drawings.
   a. Basis of Design: Timer deck plates are based upon TITANIUM SERIAL TIMER DECK PLATE as manufactured by Colorado Timing Systems, Inc.
2. Connection to timer which must allow for a pool setup without a wall plate, and must provide the following:
   a. Connectivity to timing courses and one scoreboard bus with one cable connection
   b. Detection of presence or absence of connected timer
   c. Diagnostic capabilities to detect anomalies with connectors (corrosion, shorts)
   d. In deck system components must fit into a 4” x 4” x 6” PVC junction box
3. Junction Boxes (Provided by Electrical):
   a. In deck system components must fit into a 4” x 4” x 6” PVC junction box.
   b. Conduit interconnects between boxes (deck plates and wall plates) must be PVC. Refer to drawings for sizing.
   c. Verify routing of conduit with Multi-Sport Computer/Timing System manufacturer prior to installation.

3.4 SWIMMING TIMING START SYSTEM

A. Starting System
1. Swim Timing Start System (1 required) must be provided to start the automatic Multi-Sport Computer/Timing System. The start system must be capable of driving up to twenty (20) (45 ohm) individual starting block speakers mounted under the starting blocks or two (2) underwater/aux speakers (up to 8 ohm each), the relay judging platform strobe lights and deck side start indicators with microphone.
   a. Basis of Design: Swimming Timing Start System is based upon the CHAMPIONSHIP ELITE START SYSTEM (SSE) as manufactured by Colorado Time Systems, Inc.
2. The start system must use a wired microphone and must have volume control, including base and treble.
3. The start system must have a sturdy, all metal, non-corrosive enclosure with feet. The start system should include a tripod mount (TR-3) for each start system.
4. The start system must have external connections for additional external visual indicator strobe light(s) (EVI’s), speaker output, start output and speedlights.
5. The system must run off two (2) internal lead acid batteries. The internal batteries must automatically be recharged while the starter is plugged in to the external power supply. Under typical operation the batteries must last more than 15 hours and must typically recharge in approximately 2.5 hours.
6. System must have an LED showing the battery status (green, yellow, red) when the internal batteries are starting to get low on power. Battery status percentage must be displayed on the LCD screen.
7. The start system must be compatible with an underwater speaker system (SP-UND).
8. The start system must have a standard CTS start tone and alternate start tone.
9. Loudness of start tones and under block speakers must be configurable by the end user for optimal use both indoors and outdoors.
10. The intensity of the onboard strobe and EVIs must be configurable by the end user for optimal use both indoors and outdoors.

11. The start system must include a backlit and transflective LCD screen that provides easy navigation and onboard help menus.
12. The start system must include a visual start signaling system (VSS) option to provide a clear visual start sequence for all athletes. Visual functionality includes the following: call to block (EVI blinks red), step up (EVI steady red), take your marks (EVI steady yellow), start (EVI flashes green or white). VSS must be controllable via user operated pushbutton device separate from starter microphone.
13. The start system must include a training mode that provides both a pre-recorded and customizable “take your marks” message and start signaling with a variable interval between starts. Time interval between “take your marks” and start signal must include random delay The training mode must be configurable by the user to include VSS signaling.
14. The start system must be FCC compliant, and safety listed. UL or equivalent.
15. The start system must be able to be updated by customer.
16. Provide cabling quantities required to connect the start system to the Multi-Sport Computer/Timing System including (R-015-715-8) 8M Start Cable(s) for connection to the Multi-Sport Computer/Timing System and Elite Start to wall plate cable(s).

B. Starting Block Speaker:
1. Provided one speaker per championship starting block, plus one spare speaker (7 required). The speaker must be mounted on the starting platform. Speaker must be corrosion resistant and designed for use in an aquatic environment and rated for such use.
   a. Basis of Design: The starting block speaker is based upon the CTS MODEL SP-6/45 as supplied by Colorado Timing Systems, Inc.
2. The loudspeaker must be a flex driver type horn projector of integrated construction. It must be rated 6 watts for voice or music material with an on-axis frequency response of 320-6000 Hz (“6dB). The sound pressure level must average 97dB (1W/1M) for 500 to 5000 Hz.
3. The horn and mounting base must be tan in color and constructed of impact & UV resistant ABS, which will retain mechanical properties from -20q to +160qF. The driver cone diaphragm must be moisture resistant. Materials must resist damage from extreme weather exposure. Electrical connector must be of 2-conductor banana type, 0.750 center to center.
4. Provision for mounting must include clearance slots in the adjustable base and hole location points in the horn flange for adapting unit must be recess mounted.

3.5 SWIMMING TIMING COMPONENTS

A. Gutter Hung Touchpads
1. Provide 7 touchpads (6 plus 1 spare) to time swimming, in compliance with the appropriate sanctioning body.
   a. Basis of Design: The gutter hung touchpad is based upon the AQUAGRIP GUTTER HUNG TOUCHPAD as manufactured by Colorado Timing Systems, Inc.
2. Touchpad must be constructed of an all-plastic exterior with only electrical connector metal exposed. Touchpad must be the following dimensions:
   a. Touch pad must be the TP-78G AQUAGRIP, 78” wide x 22” tall x 0.3” thick.
3. Touchpad must have a uniform fine grit and non-abrasive surface that prevents swimmer slippage in any direction.
4. Touchpad markings must have contrasting colors with a 2” black border and black end-wall cross pattern for portion covered by touchpads.

5. Touchpad brackets must be custom made to fit the pool. The Contractor to provide sufficient number of brackets for support of each touchpad. The Contractor is to provide gutter/bulkhead dimensional drawings for confirmation of custom brackets.
   a. The Contractor to provide an additional two (2) spare touchpad brackets.

B. Push Buttons
1. Provide two (2) back-up buttons for each touchpad provided plus (2 spares)
2. Back-up buttons must be plunger style buttons with a 5’ cable.

C. Swimming Timing Systems Caddies
1. Provide touchpad caddy for storing touch pads. The correct number of touchpad caddies must be supplied to store touchpads. The caddy must be sized to match timing system touch pad widths. Touchpad caddy must consist of an aluminum frame with four freewheeling casters. The Contractor is responsible for assembly. Touchpad caddy must be CAD-TP as manufactured by Colorado Timing Systems, Inc.

3.6 PACE CLOCKS

A. Pace Clock Program
1. Accessory software program must turn multi-sport computer and multi-sport scoreboard into an effective training system and coaching tool.
   a. Basis of Design: GEN7 PACE CLOCK PROGRAM as manufactured by Colorado Timing Systems, Inc.
2. Accessory software program must turn scoreboard into an effective training system and coaching tool.
3. Interface to HYTEK's "Workout Manager" software with direct download to computer timer.
4. Programmable workouts are saved into memory for up to 80 workouts.
5. Workouts display on multi-line scoreboard by lane.
6. START/STOP lanes with one keystroke, or individually.

B. Slim Pace Clocks
1. Pace clocks must be provided as required in the quantities as shown on the drawings.
   a. Basis of Design: SLIM PACE CLOCKS as manufactured by Colorado Timing Systems, Inc.
2. The pace clock must include thirteen (13”) high visibility LED digits, with variable intensity settings. The pace clock must include a rugged powder-coated aluminum enclosure, conformal coated to protect against corrosion, a real time of day clock, and must be suitable for indoor or outdoor use.
3. The pace clock must include twelve (12) operating channels to eliminate interference.
4. Pace clocks have an integrated real time of day chip (RTC). If multiple pace clocks are used in a facility, they will synchronize the time automatically.
5. The pace clock must include a wireless frequency of 2.4 GHz and have autosensing power capabilities for 120/240 VAC.
6. Pace clock must be FCC compliant, and UL listed or equivalent.
7. The pace clock must have four (13”) digits.
   a. Overall Size (H x W x D): 19.25” x 42.25” x 2.8”
   b. Weight: 15 lbs
8. The pace clock must be provided with a cable hiding end cap to hide electrical connections. The end cap must be Colorado Timing Systems model PN K-TRIM-8 or approved equal.

PART 4 EXECUTION

4.1 EXISTING CONDITIONS

A. Verify that work by others, related to this section, is installed.

B. Carefully examine the construction documents that affect the work of this section.

C. Prior to starting work, notify the Architect of defects requiring correction.

D. Protect other materials and installed work against damage while completing work in this section.

4.2 INSTALLATION

A. Provide custom cables, connectors, scoreboard mounting brackets, and fasteners.

B. Provide scaffolding and labor for mounting scoreboard and pulling cables.

C. Provide equipment in accordance with the manufacturer’s drawings and instructions.

D. Provide scoreboard mounting, Multi-Sport Computer/Timing System cable terminations, system checkout, and local operator training at time of installation. Training must consist of one 4-hour session.

E. Provide as-built drawings precisely locating items.

F. Wiring and grounding must be installed in strict accordance with the latest edition of the National Electric Code – Article 680.

END OF SECTION 13 11 06

SECTION 13 24 16 SAUNAS AND STEAM ROOMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-Cut Custom Saunas

B. Salt Saunas

C. Modular Saunas

D. Sauna Accessories.

E. Sauna Heaters.

F. Hybrid Steam Rooms.

G. Steam generator and controls.

H. Steam Room Accessories.

1.2 RELATED SECTIONS

A. Section 05 40 00 - Cold-Formed Metal Framing.

B. Section 06 10 00 - Rough Carpentry.

C. Section 07 90 00 - Joint Protection.

D. Section 09 30 00 - Tiling.

E. Section 09 30 33 - Stone Tiling.

F. Section 22 11 13 - Facility Water Distribution Piping.

G. Section 22 14 26.13 - Roof Drains.

H. Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCES

A. ASTM E 774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified shall be supplied by a single manufacturer with a minimum of 10 years documented experience.

B. Installer Qualifications: A single installer with a minimum of 5 years demonstrated experience installing products of the same type and scope as specified.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. Provide an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: AM-FINN Sauna & Steam, which is located at: 372 S. Eagle Rd. Suite 341; Eagle, ID 83616; Toll Free Tel: 800-237-2862; Tel: 208-724-8040; Fax: 208-286-0290; Email:request info (admin@am-finn.com); Web:https://www.am-finn.com

B. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00,Substituion Procedures and Substitution Request Form.

2.2 SAUNA MATERIALS

A. Lumber: Wood species and grades as follows, unless otherwise indicated:
   1. Western Red Cedar: WCLIB or WWPA; Clear Hear

B. Insulating/Tempered Glass: Preassembled units consisting of insulating/tempered-glass units made from two lites of 5/32 inch (4mm) thick with 7/16 inch (11mm) air space, clear glass double sealed. Provide jamb and casing of western red cedar and complying with ASTM E 774 for Class CBA units

C. Fasteners: Exposed: Stainless steel, or Exposed: hot-dip galvanized.

2.3 SAUNAS

A. Pre-Cut Saunas: Provide manufacturer's standard interior finishes, pre-hung door, and trim; designed to be constructed as a permanent part of the structure.
   1. Rooms must be prepared ahead of sauna installation, including studding, insulation, and plywood for attaching paneling
   2. Vapor Barrier - FSK Shield Vapor Barrier on all walls and ceilings
   3. Wood Species: Western Red Cedar, Clear Grade, S4S
   4. Interior Wall and Ceiling Paneling: 1/2 inch by 6 inches nominal V-joint, tongue-and-groove wood boards; kiln-dried to no more than 12 percent moisture content. Attached to wall vertically. Standard vertical pattern is 35 inch lower piece with 60 inch upper piece. Gap is covered by Split Wall Trim.
   5. Interior Trim: Clear Western Red Cedar
      a. Split Wall Trim (Euro-Trim): 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between 35 inch and 60 inch Wall boards.
      b. Ceiling Trim: 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between ceiling and wall boards.
      c. Corner Trim: 1 inch by 1 inch with 1/2 inch radius. Covers gap on corners.
      d. Ceiling Corner Medallion: 1-1/2 inch by 1-1/2 inch by 3-1/2 inch Medallion for top of corner trim.
      e. Base Trim: 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between wall boards and floor.
   6. Door: Manufacturer's standard, solid core, prehung door with glass vision panel as follows:
      a. Door Wood Species: Western Red Cedar.
      b. Jamb and Casing Wood Species: Western red cedar.
      c. Glass Vision Panel: Preassembled units consisting of insulating/tempered-glass units made from two lites of 5/32 inch (4 mm) thick with 7/16 inch (11 mm) air space, clear glass double sealed. Provide jamb and casing of western red cedar and complying with ASTM E 774 for Class CBA units.
      d. Size: 36 inches by 80 inches outside dimensions. Provide rough opening of 38 inches by 82 inches.
      e. All doors are undercut 1 inch to 1-1/2 inches to provide proper and sufficient air flow into sauna. Do not cut vents or other openings in sauna walls unless required for sauna heater.
      f. Door Hardware: Provide three self-closing brass hinges, and two wood door pulls (interior and exterior of door) of Western Red Cedar.
   7. Benches: ADA Compliant, Western Red Cedar, Clear Grade, S4S. All sharp edges have been broken, bench top boards have .125 inch fillet on corners, fasteners are hidden, standard 20 inch Depth and 19 inch Height. Exposed bench ends are covered

with End Caps.
   a. Standard 1 inch by 4 inch nominal wood boards, spaced not more than 1/2 inch apart and supported by 2 inch by 4 inch nominal wood framing.
8. Flooring:
   a. 2 foot by 2 foot Duckboards, 1 inch by 4 inch boards, 3/8 inch spacing, removable for cleaning
9. Lighting:
   a. Standard UL Listed Shatter-proof, water-proof light, hardwired.

B. Himalayan Salt Saunas: Provide manufacturer's standard interior finishes, pre-hung door, and trim; designed to be constructed as a permanent part of the structure.
1. Rooms must be prepared ahead of sauna installation, including studding, insulation, and plywood for attaching paneling
2. Vapor Barrier - FSK Shield Vapor Barrier on all walls and ceilings
3. Wood Species: Western Red Cedar, Clear Grade, S4S
4. Interior Wall and Ceiling Paneling: 1/2 inch by 6 inches nominal V-joint, tongue-and-groove wood boards; kiln-dried to no more than 12 percent moisture content. Attached to wall vertically. Standard vertical pattern is 35 inch lower piece with 60 inch upper piece. Gap is covered by Split Wall Trim.
5. Interior Trim: Clear Western Red Cedar
   a. Split Wall Trim (Euro-Trim): 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between 35 inch and 60 inch Wall boards.
   b. Ceiling Trim: 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between ceiling and wall boards.
   c. Corner Trim: 1 inch by 1 inch with 1/2 inch radius. Covers gap on corners.
   d. Ceiling Corner Medallion: 1-1/2 inch by 1-1/2 inch by 3-1/2 inch Medallion for top of corner trim.
   e. Base Trim: 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between wall boards and floor.
6. Door: Manufacturer's standard, solid core, prehung door with glass vision panel as follows:
   a. Door Wood Species: Western Red Cedar.
   b. Jamb and Casing Wood Species: Western red cedar.
   c. Glass Vision Panel: Preassembled units consisting of insulating/tempered-glass units made from two lites of 5/32 inch (4 mm) thick with 7/16 inch (11 mm) air space, clear glass double sealed. Provide jamb and casing of western red cedar and complying with ASTM E 774 for Class CBA units.
   d. Size: 36 inches by 80 inches outside dimensions. Provide rough opening of 38 inches by 82 inches.
   e. All doors are undercut 1 inch to 1-1/2 inches to provide proper and sufficient air flow into sauna. Do not cut vents or other openings in sauna walls unless required for sauna heater.
   f. Door Hardware: Provide three self-closing brass hinges, and two wood door pulls (interior and exterior of door) of Western Red Cedar.
7. Benches: ADA Compliant, Western Red Cedar, Clear Grade, S4S. All sharp edges have been broken, bench top boards have .125 inch fillet on corners, fasteners are hidden, standard 20 inch Depth and 19 inch Height. Exposed bench ends are covered with End Caps.
   a. Standard 1 inch by 4 inch nominal wood boards, spaced not more than 1/2 inch apart and supported by 2 inch by 4 inch nominal wood framing.
8. Flooring:
   a. 2 foot by 2 foot Duckboards, 1 inch by 4 inch boards, 3/8 inch spacing, removable for cleaning
9. Lighting:
   a. Standard UL Listed Shatter-proof, water-proof light, hardwired.
10. Himalayan Salt Panels: Himalayan pink salt bricks assembled into panels with 6 salt

bricks per panel. Panels are provided with stainless steel mounting hardware.
a. Overall Panel Size: 15.5 inches wide by 17.24 inches high by 1.75 inches thick.
b. Backlighting: Color changing LED backlighting, hardwired.

C. Modular Saunas: Prefabricated, demountable, panelized system complete with framing, 2 inch tongue and groove paneling, prehung door, conduit to bring power to the electrical control panel and from the control panel to the heater, and trim; designed to be freestanding.
1. Interior Wall and Ceiling Paneling: 2 inch by 6 inch (51 mm by 152 mm) nominal W-joint, tongue-and-groove wood boards of species and grade indicated; sanded smooth; kiln-dried to no more than 12 percent moisture content.
a. Wood Species: Western red cedar.
2. Exterior Wall Finish:
a. Solid Wall construction, 2 inch thick tongue-and-groove groove paneling serves as interior and exterior surfaces.
3. Interior Trim: Clear Western Red Cedar:
a. Split Wall Trim (Euro-Trim): 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between 35 inch and 60 inch Wall boards.
b. Ceiling Trim: 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between ceiling and wall boards.
c. Corner Trim: 1 inch by 1 inch with 1/2 inch radius. Covers gap on corners.
d. Ceiling Corner Medallion: 1-1/2 inch by 1-1/2 inch by 3-1/2 inch Medallion for top of corner trim.
e. Base Trim: 7/16 inch by 3-1/2 inch boards, mitered corners for blending. Covers gap between wall boards and floor.
4. Door: Manufacturer's standard, solid core, pre-hung door with glass vision panel.
a. Door Wood Species: Western Red Cedar.
b. Jamb and Casing Wood Species: western red cedar.
c. Glass Vision Panel: Preassembled units consisting of insulating/tempered-glass units made from two lites of 5/32 inch (4 mm) thick with 7/16 inch (11 mm) air space, clear glass double sealed. Provide jamb and casing of western red cedar and complying with ASTM E 774 for Class CBA units.
d. Door size is 36 inch by 80 inch outside dimensions with rough opening of 38 inches by 82 inches.
e. All doors are undercut 1 inch to 1 1/2 inches to provide proper and sufficient air flow into sauna. Do not cut vents or other openings in sauna walls unless required for sauna heater.
f. Door Hardware: Provide three self-closing brass hinges, and two wood door pulls on interior and exterior of door of Western Red Cedar.
5. Benches: ADA Compliant, Clear Grade Western Red Cedar, S4S. All sharp edges have been broken, bench top boards have .125 inch fillet on corners, fasteners are hidden, standard 20 inch Depth and 19 inch Height for single tier, exposed bench ends are covered with end cap.
a. Standard 1 inch by 4 inch nominal wood boards, spaced not more than 1/2 inch apart and supported by 2 inch by 4 inch nominal wood framing
6. Flooring:
a. 2 foot by 2 foot Duckboards, 1 inch by 4 inch boards, 3/8 inch spacing, removable for cleaning
7. Lighting:
a. Standard UL Listed Shatter-proof, water-proof light, hardwired.

2.4 SAUNA ACCESSORIES

A. Guardrail: Wood guardrail for heater. Dimensions as required by heater UL listing.

B. Thermometer.

C. Aluminum Hygrometer with Temperature and humidity readings.

D. Wood bucket: 1-gallon (3.8L) capacity with plastic liner and wood ladle.

2.5 SAUNA HEATERS

A. Scandia Ultra Sauna Heaters - Manufacturer's standard electric convection unit with stainless-steel interior, stainless-steel exterior. Provide heat-tested, shatter-resistant igneous rocks that are not in direct contact with heating-unit coils and are completely separated from the heating-unit coils. U.L. listed. Obtain rough-in instructions from supplier for electrical work which must be performed during build out phase prior to sauna installation. Especially critical if block or CMU wall construction is used. Conduits and location for heater control assembly on front wall are essential. Capacity as determined by manufacturer based upon square footage of sauna.
   1. Power Supply: 208 or 240-Volt and either single or three phase.
   2. Mounting: Wall mounted with bracket.
   3. Built-in Thermostat in Heater Controls: Manufacturer's T-Model system mounted integral with heater unit, with thermostat.
   4. Controls: Remote mechanical controls with thermostat and the following features:
      a. Dial timer that automatically shuts off heater after 60 minutes.
      b. Dial time-delay that allows heater to be preset up to 24-hours, seven days in advance, with manual override.

B. Scandia Ultra Gas-Fired Sauna Heaters - Double-wall heater construction. Heater chamber constructed of heavy gauge (#16 gauge) #321 spec stainless steel and exterior shell finished in louvered #304 stainless steel..
   1. Rock Capacity: Minimum 80 lbs - 40 KBTU or 160 lbs - 80K BTU).
   2. Capacity: Determined by manufacturer based upon square footage of sauna.
   3. Burner system: Cast-steel; designed specifically for sauna heater application.
   4. Gas valve and pilot system: CSA or AGA listed.
   5. Fuel source: Natural gas or liquid propane (LP).
   6. Mounting: Floor-mount with through-wall back panel assembly
   7. Rock tray: Self-contained in a cone shaped pan construction to facilitate fast heat-up time and support large amounts of water for steam production.
   8. Controls: Remote mechanical controls with thermostat and the following features:
      a. Dial timer that automatically shuts off heater after 60 minutes.
      b. Dial time-delay that allows heater to be preset up to 24-hours, seven days in advance, with manual override.

2.6 FABRICATION

A. Fabricate saunas to dimensions, profiles, and details indicated. Sand boards smooth and ease edges to a radius of not less than 1/16 inch (1.6mm).

B. Complete fabrication of Modular sauna panels, including assembly and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation.

C. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Nail or screw bench components together from bottom side. Countersink fasteners.

E. Secure glass in wood frames with removable stops.

F. Flush mount junction boxes for heater, control panel, and light fixtures, with concealed connecting electrical conduit.

2.7 ADVANCED HYBRID STEAM ROOMS

A. Prefabricated, packaged unit, complete with fittings, door, benches, ceiling, flooring, lighting, and accessories.
   1. Frame made of 1 inch by 2 inch by 0.125 inch Aluminum Tubing Uprights, Ceiling Trusses, and Cross-Members, manufactured and pre-assembled in manufacturers production facility.
   2. Composite cell-cast acrylic wall and ceiling panels, walls are 1/2 inch thick, ceiling panels are 3/8 inch, overall panel dimensions 48 inch by 120 inch
   3. Risers for ceiling sloping made of 1.5 inch Aluminum L-Angle
   4. White PVC Corner Trim 1-1/2 inch by 1-1/2 inch.
   5. Finish: High glazed, white color. Can have floor to ceiling acrylic, or have Window Risers to set the ceiling slope and add another lighting feature as well. Different Colors and Custom print options available
   6. Highly customizable, can be designed to fit into odd or custom room sizes.

B. Capacity and Dimensions: Consult supplier for appropriate model.

C. Door: All glass door mounted on powder-coated aluminum frame with custom colors available.
   1. Glass: 3/8 inch (9 mm), tempered.
   2. Opening: 36 inches by 72-1/4 inches (914 mm by 1835 mm). Glass size 36 inch by 82.75 inch, Frame size 38-1/2 inch by 85 inch with required rough openings of 40 inches by 86 inches.
   3. Opening: 36 inches by 84 inches (914 mm by 2134 mm).
   4. Hinge: 304 Stainless steel gravity hinges with mirror finish.
   5. Door Pulls: 10 inch (254 mm) chrome door pulls.
   6. Door Swings out of steam room for user safety.

D. Lighting:
   1. LED back-lighting to be mounted on custom acrylic ceiling risers.
      a. LED strip placed outside the room around the perimeter of the Risers, providing a semi-opaque window that filters in the LED light to the room. Receiver and transformer are encased in a waterproof electrical box that sits underneath the bench, and goes through the acrylic walls. Provide 120V power to GFCI that sits inside waterproof box.
      b. LEDs are controlled by remote control, and should be placed on their own circuit to ensure that the circuit is not being turned on and off.
   2. Center LED Lighting Strip
      a. LED Strip encased in waterproof channel with clear plastic cover, controls and transformer are encased in a waterproof electrical box that sits underneath the bench, and goes through the acrylic walls. Provide 120V power to GFCI that sits inside waterproof box.
      b. LEDs are controlled by remote control, and should be placed on their own circuit to ensure that the circuit is not being turned on and off.
   3. Above Ceiling LED lights, "Moonglow Ceiling"
      a. Two shop LED lights, these are hardwired together using Armorlite 12/2 Metal Clad Cable, as well a 10ft chord of the same Armorlite 12/2 will be provided to finalize a connection to Jbox.
      b. These cannot be on the same circuit as the LED control box

E. Seating:
   1. Bench Tops and Frame: Fabricated from Marine Grade HDPE, 20 inch Depth, 12 inch by 0.5 inch slots spaced equally across bench, 6061 Aluminum L-angle underframe used to attach to wall brackets and connect benches together for stability
   2. 1 Tier benching comes with 3 inch skirting strip, covering aluminum frame
   3. 2 Tier benching comes with 18 inch full skirting, slots matching bench tops

4. Legs: 14 Gauge 304 Stainless Steel tubing with a stainless faceplate welded to the top for fastening to bench tops. Heavy Duty Adjustable feet inserts, corrosion resistant and allows for height and angle adjustments.
5. Wall Brackets: 1 inch by 2 inch 6061 Aluminum square tubing, 0.125 inch wall thickness. 0.75 inch L-angle welded on top, creating a wall bracket that both supports the benches, holds them closely to the wall, and allows for benches to be removed

F. Ceiling:
1. "Moonglow Ceiling" Semi-opaque white acrylic panels backlit by LED Shoplight
2. Paneled Brushed Stainless-Steel Ceiling
3. Combination of Moonglow and Stainless Steel, "Racing Stripes"

G. Storefronts:
1. Storefronts or vision panels made from either clear acrylic or glass depending on the size, 6061 Aluminum frame, Aluminum L-angle used to hold the acrylic or glass in position, gasket placed in between the L-angle and other material to create watertight seal. Aluminum powder-coated to match storefront.

2.8 STEAM GENERATORS AND CONTROLS

A. Generator:
1. Size generator as recommended by manufacturer for volume of steam room and type of construction materials employed.
2. Provide manual or automatic controls with on/off, temperature setting, and time setting.
3. Provide steam heads designed not to exceed 125 degrees F (52 degrees C).
4. Eucalyptus pump/Aroma Dispenser.

B. Generator Model No. _____- Size according to room dimensions and voltage.

2.9 STEAM ROOM ACCESSORIES

A. Dual Filter Scale-X Cartridge.

B. Aroma Guard II.

C. Power Zone 400 Ozone o3 generator cleaning system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough-ins for all utilities are properly sized and in correct locations.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 SAUNA INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install sauna components level, plumb, true, and straight with no distortions. Shim, as required, with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96 inches (1.6 mm in 2400 mm) vertical cup or bow and 1/8 inch in 96 inches (3 mm in 2400 mm) horizontal variation from a true plane.

C. Where local code requires installation of sprinkler heads inside sauna, insure heads are rated at a high enough temperature to withstand the heat which will collect at the ceiling of the sauna. Recommended sprinkler rated for temperatures between 250-300 degrees.

3.4 STEAM ROOM INSTALLATION

A. Hybrid Steam Room Enclosures: Install prefabricated panels to final room dimensions in accordance with manufacturer's assembly instructions; lock panels into place

B. Steam Generators and Accessories: Install and connect steam generators, steam outlets, controls, and temperature sensors. Coordinate with work of mechanical and electrical sections, and connect to utilities.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 13 49 13 - INTEGRATED X-RAY SHIELDING ASSEMBLIES PART 1 GENERAL

1.01 SECTION INCLUDES

A. Construction of lead enclosure around x-ray treatment rooms and control rooms.

B. Lead sheet applied to gypsum board.

C. Radiation treatment room view window frames.

D. Leaded glass.

E. Lead-lined radiation-shielded solid core wood doors.

F. Lead-lined hollow metal door frames.

G. Related accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames:

B. Section 08 1416 - Flush Wood Doors:

C. Section 08 7100 - Door Hardware: Lead-lined door hardware.

D. Section 09 2116 - Gypsum Board Assemblies: Joint taping over lead lined gypsum board.

E. Section 09 9000 - Painting and Coating: Field painting.

1.03 REFERENCE STANDARDS

A. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2014.

B. ASTM C 954: Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

C. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

D. NCRP Report 147 - Structural Shielding Design and Evaluation for Medical Uses of X Rays and Gamma Rays of Energies up to 10 MeV; 2004.

E. Federal Specification QQL-201 F Grade C.

F. Hollow Metal Manufacturers Association (HMMA) 840 - Installation and Storage of Hollow Metal Doors.

G. National Council on Radiation Protection and Measurements (NCRP):
   1. NCRP Report No. 145 - Radiation Protection in Dentistry.
   2. NCRP Report No. 147 - Structural Shielding for Medical X-Ray Imaging Facilities.
   3. NCRP Report No. 151 - Structural Shielding Design and Evaluation for Megavoltage X- and Gamma Ray Radiotherapy Facilities.

H. Steel Door Institute (SDI)-100 - Recommended Specifications for Standard Steel Doors and Frames.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate this work with the construction of the building elements that x-ray protection is applied to or installed in.

B. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Shop Drawings: Indicate layout, details, dimensions, interface with adjoining work of radiation protected areas .
   1. Indicate details, dimensions, finishes, and interface with adjoining work.
   2. Indicate lead thickness or lead equivalencies of components.

C. Product Data: Provide data on leaded glass and all products to be used.

D. Manufacturer's Certificate: Certify that walls, leaded glazing capabilities frame, door capabilities and frame meet or exceed the provisions of the National Council of Radiation Protection, (NCRP)..

E. Initial Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (152 mm) square, representing actual product, color, and patterns.

G. Manufacturer's Instructions:
   1. Preparation and installation instructions and recommendations.
   2. Storage and handling requirements and recommendations.

H. Qualification Statements:
   1. Manufacturer.
   2. Installer.
   3. X-ray physicist.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: Cleaning instructions for leaded and acrylic glass.

B. Record Documentation: Record Drawings, with dimensions, showing locations of radiation protection.

C. Radiation Protection Survey: Record copy of physicist’s Radiation Protection Survey indicating measurements and evaluation of measurements of installed radiation shielding materials.

D. Manufacturer’s Certification: Upon completion of radiation protection work, Manufacturer and Installer shall furnish a certificate of compliance that all materials are in accordance with the specifications and physicist’s radiation protection survey.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with NCRP Report 147 and Report No. 049 - Structural Shielding Design and evaluation for Medical Use of X-Rays and Gamma Rays of energies uo to 10 MeV regulations.1. Comply with requirements of local regulatory agencies where local standards and criteria exceed requirements of NCRP Report Nos. #145, #147 and #151.

B. Maintain one copy of each document on site.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years documented experience.

D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of.

E. Single Source Responsibility: Obtain radiation protection materials and accessories produced or distributed as standard products from single manufacturer regularly engaged in production of X-ray and gamma ray shielding materials. Ensure all materials are compatible and coordinated to meet performance requirements as specified.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable health and occupation code for integrity of radiation protection and continuity of protected construction.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instruction for receiving, handling, storing, and protecting materials.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Store materials in original packaging, protected from exposure to harmful environmental conditions, including static electricity, and at temperature and humidity conditions recommended by manufacturer.

D. Exercise care to prevent edge damaged materials.

1.10 FIELD CONDITIONS

A. Ambient Conditions: Maintain temperature, humidity, and ventilation condition within limits recommended by manufacturer for optimum results. Do not install products under ambient conditions outside manufacturer's absolute limits.

B. Lead-Laminated Gypsum Board:
   1. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
   2. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
   3. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
      a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
      b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.11 COORDINATION

A. Coordinate the work of this Section with the respective trades responsible for installing interfacing work.

PART 2 PRODUCTS

2.01 DESIGN REQUIREMENTS:

A. Provide materials and workmanship, including joints and fasteners, that maintain continuity of radiation protection at all points and all directions equivalent to materials specified in thicknesses and locations indicated.
   1. Employ a physicist knowledgeable in radiation protection for medical facilities to determine thicknesses and configurations of lead-lined materials.

B. Lead-Lined Assemblies: Provide lead thickness in gypsum board, plywood, doors, door frames, window frames, and other items located in lead-lined assemblies, not less than that indicated for assemblies in which they are installed unless indicated otherwise.

C. Lead Glazing: Provide lead equivalence not less than that indicated for assembly in which glazing is installed unless indicated otherwise and approvals by radiation physicist.

2.02 MANUFACTURERS:

A. Wood Doors: Masonite Architectural Lead Lined or approved equal.

B. Door and Window Steel Frames: A&L Shielding, Lead Lined - welded hollow metal door frames or approved equal.

C. Glazing: TGP LX-57B x-ray Shielding Glass (LX7) or approved equal.

2.03 LEAD SHEET AND ASSOCIATED MATERIALS

Lead sheets and all associated materials are to be approved by the radiation physicist.

A. Lead Sheet: 99.9 percent or better pure unpierced virgin lead, free from dross, oxide inclusions, scale, laminations, blisters, and cracks.
   1. Sheet Lead shall meet or exceed the Federal Specification QQL-201 F Grade C and ASTM B749-03 Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate

Products, see NCRP reports #145, #147 and #151.
2. Thickness: As determined by Radiation Protection Survey, but not less than 1/16 inch (1.5 mm) if not indicated.
3. Variation in Sheet Thickness: Not to exceed five (5) percent.

2.04 LEAD-LAMINATED GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated

2.05 LEAD-LAMINATED GYPSUM BOARD

A. Lead-Laminated Gypsum Board: Single unpierced layer of sheet lead laminated to back of gypsum board.

2.06 RADIATION SHIELDING LEADED GLASS

A. Radiation Shielding Leaded Glass: Clear leaded glass containing 48 percent lead oxide (by weight) and 15 percent barium. Thickness as required to provide radiation protection equivalent to that provided by sheet lead in partition in which lead glass is installed.
1. Thickness: 8.0 mm (5/16") yielding an equivalency of 2.0 mm (1/16").

2.07 LEAD-LINED TWO-PIECE SLIP FRAMES

A. Lead-Lined Telescopic View Window Frames: Two-piece slip lead lined frames manufactured to a specific throat dimension to suit wall thickness. Frames shall be capable of accepting any thickness of radiation shielding leaded glass, radiation shielding X-Ray safety glass, or radiation shielding leaded acrylic. Frame corners shall be fully welded and ground smooth.
1. Throat Dimension: As required to suit wall thickness.
2. Metal Thickness: 16 gauge.
3. Provide radiation protection equivalent to that provided by sheet lead in partition in which view window is installed.
4. Provide ½" (13 mm) removable, reversible stops. Predrill and countersink to allow for:
   a. One pane of 5/16" leaded shielding glass.

2.08 LEAD-LINED SOLID CORE WOOD DOORS

A. Flush veneered construction using single layer of sheet lead in center of door. Laminate wood cores under hydraulic pressure on each side of lead.
1. Extend sheet lead lining to door edges providing X-Ray absorption equal to partition in which door occurs.
2. Shield cutouts for lock sets with sheet lead lapping, lead lining of lock sets or door lining, of equal thickness lead as used in door of same opening.
3. Further bond cores with 6 poured lead dowels at the following locations:
   a. 2 at 8 inches (203 mm) from top and 4 inches (102 mm) sides, 2 at center 4 inches from sides, and 2 at 8 inches (203 mm) from bottom and 4 inches (102 mm) sides.
4. Edge Strips: Minimum thickness of 2 inches (51 mm) each edges of door.
   a. Species: Same as wood face veneer. Section 08 1416 Flush Wood Doors
   b. Glue strips to cores before face veneer is applied.
   c. Extend vertical edge strips full height of door and bevel 1/8 inch (3 mm) for each 2 inches (51 mm) of door thickness.
5. Face Veneer for Transparent Finish: Match species and finish of Section 08 1416 Flush Wood Doors of existing doors.
6. Mineral Core with Lead: Radiation Shielded
7. Lead thickness per drawings and Radiation Physicist's approvals.
8. Fire Rating: per drawings
9. Astragal at Pairs: Lead-lined meal Edge & Astragal

10. Warranty: Full; Life of original installation

2.09 LINED HOLLOW METAL DOOR FRAMES

A. Lead-Lined Hollow Metal Door Frames:
   1. Construction: Line inside of frames with single unpierced strip of sheet lead of not less than same thickness as lead in doors and walls in which installed.
      a. Form lead sheet to match contour of frame on radiation exposure side of frame, continuous in each jamb and across head and over lap into formed stop.
      b. Form lead shields around areas prepared to receive hardware.
      c. Fabricate lead lining wide enough to maintain an effective 1/2" (13 mm) minimum overlap lap with lead of adjoining shielding.
      d. Design lead-lined door frames to accommodate lead lining up to 1/2 inch (13 mm) thick.
   2. Door Frame Supports: 2-1/4 inches (57 mm) steel angle iron.
   3. Jamb Depth: 4 7/8”, or as required.
   4. Jamb Profile: 2”
   5. Head Profile: 2”
   6. Joints mitered with integral tabs for interlocking and reinforcing
   7. Interlapping lead joints to ensure continuity of shielding per drawings
   8. Frames plumbed and square, installed and approved by architect prior to installation of lead lined drywall

2.10 ACCESSORIES

A. Lead Discs: 5/16 inch (8 mm) diameter lead discs for use with screw heads.

B. Lead Strips: 2 inches (51 mm) wide, unless indicated otherwise, by same thickness as sheet lead laminated on gypsum board.

C. Lead Angles: Leak-proof, lead angle system providing complete coverage of gamma rays used in lieu of lead strips and lead discs where sheet lead thickness is greater than 1/8 inch (3 mm) thick.

D. Gypsum Board Fasteners:
   1. Screw Fasteners for Metal Framing - Self Tapping: Type S, bugle head self-piercing tapping screws complying with ASTM C 1002, length as required, for applying lead-laminated gypsum board to light gage metal framing having thickness of 0.033 to 0.112 inch [0.84 to 2.84 mm] thick.

E. Adhesive: Acceptable to radiation protection product manufacturer and capable of adhering lead sheets where required.

F. Tie Wire: Leaded steel, annealed.

2.10 FINISHES

A. Field Painted Surfaces: Color as selected by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing surfaces are ready to receive work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION OF LEAD-LAMINATED GYPSUM BOARD

A. Comply with manufacturer's recommendations.

B. Specifier Note: Lead strips are not required on 49” or greater lead sheet widths. Delete this paragraph only if 49” or greater lead sheet widths are specified.

C. Lead Strips: Adhere lead strips on face of studs at joints in lead-laminated gypsum board, including inside and outside corners. Use 2 inches (51 mm) wide strips by same thickness as sheet lead laminated on gypsum board.

D. Shim studs and other framing members as necessary to provide flat, flush finished surfaces.

E. Install lead angles per manufacturer's recommendations.

F. Install lead-laminated gypsum board on framing with screws spaced not more than 8 inches (203 mm) on center along edges of board and 12 inches (305 mm) on center in field of board.

G. Adhere lead discs to fastener heads. In each case, use method that provides continuous radiation shielding.

H. Where lead-laminated gypsum board is final substrate, apply joint treatment on fasteners and joints per “Section 09 2916 - Gypsum Board Assemblies.”

I. Where second layer of gypsum board occurs over lead-laminated gypsum board, comply with “Section 09 29160 - Gypsum Board Assemblies” for application of second layer.

3.03 INSTALLATION OF DOORS AND FRAMES

A. Lead-Lined Frames: Install lead-lined steel door frames in accordance with “Section 08 1113 - Hollow-Metal Doors and Frames.” Comply with NAAMM HMMA 840 unless otherwise indicated. Set frames accurately in position, plumb, and braced securely until permanent anchors are set.
   1. Secure door frames with steel stud anchors if lead lining is below 1/8 inch (3 mm) thick.
      a. Door Frame Supports (utilize if lead thickness is 1/8 inch (3 mm) or greater):Run steel angle supports full height on each door frame jamb and fasten to structure above.
      b. Spot-weld supports at 6 inches (152 mm) along jambs and at corners of jambs and head frame.
      c. Anchor frame to substrate with fasteners appropriate for substrate.
      d. Apply coat of asphalt mastic or paint to lead lining in door frames where lead will come in contact with masonry or grout.
   2. Provide 3 anchors per jamb, located adjacent to hinge on hinge jamb, and at corresponding heights on strike jamb.
   3. In metal stud construction, use wall anchors attached to studs with screws.
   4. Lap lead lining of frames over lining in walls at least 1 inch (25 mm).
   5. Lead Lining of Frames: Line inside of frames with lead of thickness not less than that required in doors and walls in which frames are used. Form lead to match frame contour, continuous in each jamb and across head, lapping stops. Form lead shields around areas prepared to receive hardware. Lap lining over lining in walls at least 1 inch (25 mm).

B. Lead-Lined Wood Doors:
   1. Install lead-lined wood doors in accordance with “Section 08 1416 - Flush Wood Doors” unless otherwise indicated
   2. Install doors in frames level and plumb, aligned with frames and with uniform clearance at edges.

C. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. Refer to “Section 08 7100 - Door Hardware” for other installations requirements.

D. Touch up damaged finishes with compatible coating after sanding smooth.

3.04 INSTALLATION OF WINDOW FRAMES

A. Set unleaded side of frame plumb and square in wall opening on control room side of wall with

shims.

B. Set leaded side of frame plumb and square in wall opening on X-Rayside of wall.

C. Compress sides together against faces of wall.

D. Install setting blocks, shims, and glazing tape in glazing channel to prevent galls from touching steel frame.

E. Install radiation resistant glazing in telescopic frame.

F. Place steel stops in position and mark location of stop and frame retaining holes on steel frame.

G. Remove glazing and drill holes in steel frame.

H. Place glazing and stops and hand drive setting screws.

3.05 INSTALLATION OF PENETRATING ITEMS

A. At penetrations of lead linings; provide lead shields to maintain continuity of protection.

B. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.

C. Cut wall penetration covers from lead sheet of equal or greater thickness than backing on adjacent wall panels. Cut wall penetration covers to size required to cover wall penetrations with laps 1 inch (25 mm) minimum wide as indicated on penetration detail drawings.

D. Adhesive-apply lead sheet penetration covers on penetrating boxes and raceways and return penetration covers to backside of lead-backed wall panels with 1 inch (25 mm) minimum laps.
   1. Do not use penetrating fasteners unless indicated otherwise.

E. Outlet Boxes and Conduit: Install between studs using steel telescoping mounting brackets. Cover or line with lead sheet lapped over adjacent lead lining at least 1 inch (25 mm). Wrap conduit with lead sheet for 10 inches (250 mm) in from box.

3.06 INSTALLATION OF WALL PENETRATION COVERS

A. Duct Penetrations With 8 PSF or Less Lead Sheet:
   1. Wrap ducts with wall penetration covers, lapping lead joints 1 inch (25 mm) minimum.
   2. Secure lead sheet in place with 1 inch (25 mm) minimum width steel bands spaced not more than 12 inches (305 mm) on center.
   3. Do not cut into lead sheet with tightening steel bands.

B. Duct Penetrations with Greater than 8 psf Lead Sheet and Where Duct Shielding Exceeds 24 Inches (610 mm) in Width:
   1. Laminate wall penetration covers to plywood or other similar structural panels conforming to shape of duct, lapping lead joints 1 inch (25 mm) minimum.
   2. Secure lead laminated panels to ducts with mechanical fasteners located at duct seams and corners.
   3. Where necessary to prevent lead laminated panels from overloading duct supports, independently suspend panels from hangers secured to overhead building structure.
   4. Cover fastener heads with lead sheet matching thickness of adjacent lead.

C. Piping: Unless indicated otherwise, wrap piping with lead sheet for 10 inches (250 mm) from point of penetration.

3.07 ACCESSORY INSTALLATION

A. Comply with manufacturer's recommendations.

B. Wherever lead protection is penetrated, cut, or punctured, assure continuity of shielding by use of sheet lead, lead plugs or other approved method.

C. Install sheet lead lining within steel door frames to provide radiation protection to levels indicated or levels required to match adjacent wall protection.

D. Wrap electrical outlet boxes, view window frames, and other penetrations through lead barrier

material with sheet lead to provide radiation protection to levels indicated or levels required to match adjacent wall protection.

3.08 INSTALLATION - COMPONENTS AND ACCESSORIES

A. Install components and accessories in accordance with manufacturer's instructions.

3.09 FIELD QUALITY CONTROL

A. Radiation Protection Survey: Employ a registered X-Ray physicist, certified by American Board of Radiology, for testing specified radiation protective Work and to conduct radiation protection survey of facility after radiation shielding materials are installed.
   1. Take radiation measurements and indicate evaluation of measurements in report. Submit report to Architect and Owner upon completion of report.
   2. Take radiation measurements in locations indicated by Architect.

B. Correct deficiencies in, or remove and replace, radiation protection Work that testing indicates does not comply with specified requirements.

3.10 ADJUSTING

A. Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

3.11 CLEANING

A. Remove excess materials from site and leave Work areas broom clean.

B. Leave exposed surfaces ready for site finishing.

3.12 PROTECTION

A. Lock radiation-protected rooms once door hardware is installed. Limit access to only those persons performing Work in radiation-protected rooms or as directed by Owner.

B. Tape temporary paper signs on radiation-resistant walls with the following text:
   1. “Do not mount equipment on this wall without covering penetrating fasteners with lead sheet of thickness required by Contract Documents."

3.13 SCHEDULES

A. Viewing window between Control Room and X-Ray Room.

END OF SECTION

DIVISION

14

CONVEYING EQUIPMENT

SECTION 14 21 23.16
MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Machine room-less electric traction passenger elevators as shown and specified. Elevator work includes:
   1. Gearless electric traction passenger elevators.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Accessibility provisions for physically disabled persons.
   5. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   6. Materials and accessories as required to complete the elevator installation.

B. Related Sections:
   1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
   2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
   3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
   4. Division 5 Metals:
      a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
   5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
   6. Division 16 Sections:
      a. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product)
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
   7. Division 22 Plumbing
      a. Sump pit
   8. Division 23 Heating, Ventilation and Air Conditioning
      a. Heating and ventilating hoistways and/or control room.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 2 for traction elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal, since it is a part of the building construction.
   1. A plumb and legal hoistway, properly framed and enclosed an including a pit of proper depth, and a pit ladder for each elevator. Hoistway walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point. Drains, lights, access doors, waterproofing and hoistway ventilation, as required.

2. Elevator controller space
    a. Door jamb controller option - controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the top floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Final location must be coordinated with elevator contractor. These requirements must be coordinated between the general contractor and the elevator contractor.
    b. Control room option - provide a suitable control closet with access and ventilation in accordance with all applicable codes and regulations. The control closet shall be maintained at a temperature between 32 F (0 C) and 104 F (40 C). To be measured at 6 feet (1830 mm) above the floor and 1 foot (305 mm) out from the front center of the car controller(s). Relative humidity is not to exceed 95% non-condensing. Local codes may require tighter temperature ranges, and higher ventilation levels, please check with your local code authority for the exact requirements in your area. If your control closet temperatures exceed these requirements, contact your local TK Elevator sales representative for assistance. All telephone wiring to controller room control panel, and installation of telephone instrument or other communication equipment in elevator cab with all connections to elevator in controller room.
3. Hoistway must be maintained between 32ºF (0ºC) and 122ºF (50ºC) measured at the machine.
4. Adequate supports to carry the loads of all equipment, including overhead machine and machine beams located in hoistway including supports for guide rail brackets.
5. Complete 3 phase connections from the electric power mains to each controller, including necessary circuit breakers and fused mainline disconnect switches unless otherwise specified herein by elevator manufacture.
6. Electric power of the same characteristics as the permanent supply without charge for the construction, testing and adjusting.
7. Provide proper piping and conduit.
8. Divider beams for rail bracket support as required.
9. Cutting of walls floor, etc. and removal of such obstructions as may be necessary for proper installation of the elevator.
10. Grouting of door sills, hoistway frames, and signal fixtures after installation of the elevator equipment.
11. All painting, except as otherwise specified.
12. Provide hoistway walls designed and constructed in accordance with the required fire rating (including those places where elevator fixture boxes, rail bracket fastenings, and any other penetration into the hoistway walls).
13. Temporary enclosures, barricades and other protection from open hoistways and elevator work area during the time the elevator is being installed to meet all permanent installation safety codes. A temporary work platform to be provided at the top landing across the hoistway; if required, it should conform to all code and safety requirements.
14. Smoke detector\ sensing devices and contacts wired to elevator control as required by local code. A means to automatically disconnect the main line power supply to the elevator prior to the application of water in the elevator controller room shall be furnished by the electrical contractor. This means shall not be self-resetting.

15. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
16. A standby power source, including necessary transfer switches and auxiliary contact, where elevator operation from an alternate power supply is required.
17. Adequate storage facilities for elevator equipment prior to and during installation at ground level within 150 feet of hoistway.
18. Setting of anchors and sleeves.
19. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
20. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
21. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
22. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.

1.02 SUBMITTALS

A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:
   1. Show equipment arrangement in the corridor, pit, and hoistway and control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Powder Coat paint selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

D. Plastic laminate selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

E. Metal Finishes: Provide standard metal samples for finishes indicated in Drawings.

F. Operation and maintenance data. Include the following:
   1. Owner’s manuals and wiring diagrams.
   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
    1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
        a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
    2. The manufacturer shall have a documented, on-going quality assurance program.
    3. ISO-9001:2000 Manufacturer Certified
    4. ISO-14001:2004 Environmental Management System Certified

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
    1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
    2. NFPA 70 National Electrical Code.
    3. NFPA 80 Fire Doors and Windows.
    4. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
    5. Section 407 in ICC A117.1, when required by local authorities

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:

    1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
    2. Arrange for inspections and make required tests.
    3. Deliver to the Owner upon completion and acceptance of elevator work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
   1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
   2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
   3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide TK Elevator’s evolution 200 Self-Supported Machine Room-Less elevator or comparable product by one of the following:
   1. Kone Elevator.
   2. Otis Elevator.
   3. Schindler Elevator.

2.02 MATERIALS, GENERAL

B. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and flooring are as indicated in the Drawings and intended to be taken from manufacturer’s full range of available finishes or as otherwise indicated for finishes such as flooring selected that may not be by the elevator manufacturer.

C. Colors, patterns, and finishes: As indicated in the Drawings.

D. Steel:
   1. Shapes and bars: Carbon.
   2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
   3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture’s standard selections.

E. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture’s standard selections.

F. Flooring by others. Flooring as indicated in Drawings – provide appropriate cab bottoms for indicated flooring materials.
    1. Cars 1 and 2 – Terrazzo floor finish.
    2. Car 3 (Service Car) – LVT
    3. Cars 4 and 4 - Carpet

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Deflector Sheaves: None

D. Guide Rails: Dry, non-lubricated steel, fastened to the building with steel brackets.

E. Guides: Guide shoes or roller guides with a minimum of three tires shall be mounted on top and bottom of the car and counterweight frame and be held in contact with the guide rail by adjustable devices.

F. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

G. Machine: The hoisting machine shall be a compact energy efficient permanent magnet Gearless traction type, consisting of PMAC motor, brake and driving sheave mounted on a rigid bedplate in the top of the hoistway. A large solid, forged shaft shall serve as a support for the motor rotor assembly and for the drive sheave and brake system. It shall be supported by roller bearings mounted in the machine housing.

H. Drive System:
    1. The drive system shall be of the Variable Voltage Variable Frequency (VVVF) regenerative.
    2. The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two-step process to a variable voltage variable frequency power supply for use by the hoist motor.
    3. The speed control shall be by means of vector control providing direct torque and field excitation automatically provided by permanent magnet. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.
    4. Dual solid state electronics (IGBT Insulated Gate Bipolar Transistor) in series shall be used in place of mechanical contactors.

I. Motor/Machine: The motor shall be PMAC, totally enclosed, non-ventilated with class "B" insulation. Ventilation fans are used if the situation requires a larger motor such as systems requiring six belts or speeds greater than 350 fpm. The motor armature shall be dynamically balanced and supported by roller bearings of ample capacity. The armature and driving sheave shall be properly balanced for smooth, high-speed elevator performance. The PM machine shall be mounted horizontally in the top of the hoistway in a unitized formed steel structure on bearing plates furnished by the elevator installer. The unitized formed steel structure shall be mounted on the guide rails provided by TK Elevator.

J. Brake: The brake shall be a spring applied electric brake; held open by an electro-magnet actuated by a digital brake controller and designed to make smooth, positive stops. The Brake shall be designed to automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be used in the actuation of the brake.

K. Suspension Belts and Governor Rope: Suspension belts shall be flat belts of polyurethane with an inner core of 12 steel cords with an FT1 fire rating such that hoistway sprinklers are not required by NFPA-13. Each belt shall have a suspension strength of 60 KN (13,488 pounds).
    1. Four to six belts shall be used depending on the car capacity.
    2. Suspension tension monitor shall detect differences in belt tension and for loss of tension. If fault is detected, the car shall stop at the nearest floor and an Out of Service call be registered.
    3. Trip criteria shall be monitored and data shall be stored in redundant non-volatile locations. Belts shall be replaced prior to the end of service life. Messages shall be issued at 180, 90, and 30 days prior to the last day of service life.
    4. Governor ropes shall be of iron construction.
    5. Any special tools, devices, software or equipment required for monitoring the wear of suspension shall be included with the installation of the equipment and become the property of the owner at time of elevator completion. This includes special ongoing monitoring systems, special tools and instruction needed to monitor the suspension system.

L. Counterweight: Counterbalance each elevator for smooth and economical operation by using iron or steel plate weights securely fastened in a steel counterweight frame. Counterweight shall equal the weight of the complete elevator car and approximately 50 percent of the specified capacity load.

M. Safety and Governor: Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds.

N. Emergency Terminal Limits: Place electric limit devices in the hoistway near the terminal landings. Limit switch(es) shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.

O. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

2.04 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
   1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
   2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.
   3. Typical door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
   1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
   2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
   3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.05 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type TKS, reinforced cold-rolled steel. Walls shall be constructed of stainless steel, no. 4 brushed finish.
   2. Reveals and frieze: Not Applicable
   3. Canopy: Cold-rolled steel with hinged exit.
   4. Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.
   5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel
   6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: Stainless steel panels: No. 4 brushed finish.
      b. Cab Sills: Extruded aluminum, mill finish.

7. Handrail: Provide 2' flat metal bar on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
9. Protection pads and buttons: Not required

B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.06 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
   1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
   2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
   3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
   4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
   5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
   6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.

7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.07 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel: No

D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

Special Equipment:
Limited Access Operation: Keyswitch and card reader space.(card reader by others)

2.08 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down"

buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.

3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
4. A car that is stopping for the last hall call in the preference direction, and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which shall maintain the preference. If no car call is registered before the door is almost closed, the car shall lose its preference and shall be available to accept calls in either direction.

B. Operation: Selective Collective – ETA based. The system is optimized to get a car to the floor where a hall call has been registered, in the shortest time. The system receives input information from standard call pushbuttons located in the hall, car position and car load information from individual car load weighers.

1. When group operation is required, the group supervisory operation shall be embedded within selected car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time for arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car’s status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.
2. Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.
3. Artificial Intelligence: Artificial Intelligence shall be an integral part of the group control system software. The enhanced artificial intelligence shall optimize the interfloor traffic performance. Inputs for the artificial intelligence shall include accurate passenger load from an electronic loadweigher, probable car calls generated from each hall call, type of building and observed traffic patterns.

C. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.
    1. The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 50 pound (23 Kg.) load change under all conditions.

2. The load sensor shall use a load cell to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.

D. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.

E. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.

F. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.

G. Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic loadweigher shall determine the load on the car determining a pre-torque reference to send to the drive.

H. Emergency Power Operation: (Group 10-D4A) Upon loss of normal power, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby power is available, one elevator at a time from each group will be lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed and the car shuts down. The next available car in the group will then be selected to lower, allow passengers to exit, close the doors and shutdown. This process is repeated until all cars in the group have been lowered and parked. At this time, an elevator is automatically allowed to continue service using the building-supplied standby power. A manual selection switch is available to override the automatic selection and allow and car in the group to provide service to the building. When normal power is restored, the elevators automatically resume operation.

I. Destination Dispatch: Not Applicable

J. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

2.09 HALL STATIONS

A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
   1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
      a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: An electronic dot matrix position indicator shall be provided and mounted for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing which the elevator is stopped or passing. When hall lanterns are provided, the position indicator shall be combined with the hall lanterns in the same faceplate. Faceplates shall match hall stations. Provide at all typical landings.

D. Hall lanterns: Not Applicable

2.10 CONTROLLER LOCATION

A. A control closet shall be provided remote to the hoistway. The control closet for simplex cars shall be 5'-6" x 6'-4" x 7'-6" high minimum size. For two-car group operation, the control closet shall be 8'-0' x 5'-6" x 7'6" high minimum. The control closet must be located within a distance that limits the wire length to 150'-0" or less from the elevator machine to elevator controller. The control closet shall have a 3?-0? wide door minimum. The control closet disconnect is provided by others. A disconnect shall be provided by others for each elevator in the optional control closet.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
    1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
    2. Comply with the National Electrical Code for electrical work required during installation.

B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment,

inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

I. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
    1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Cars 1 and 2 - Elevator Qty. 2
   1. Elevator Model: evolution 200
   2. Elevator Type: Gearless Traction Machine Room-Less, Passenger
   3. Rated Capacity: 5000 lbs.
   4. Rated Speed: 200 ft./min.
   5. Operation System: TAC32T
   6. Travel: 34'-0"
   7. Landings: 3 total
   8. Openings:
      a. Front: 3
      b. Rear: 0
   9. Clear Car Inside: 5'-8" wide x 8'-5" deep
   10. Inside clear height: 7'-4" standard
   11. Door clear height: 7'-0" standard
   12. Hoistway Entrance Size: 4'-6" wide x 7'-0" high
   13. Door Type: Two-speed | RH-LH Side opening
   14. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
      a. Note: Isolation Transformer required for jobs with less than 480vac, 3 Phase building power.
   15. Seismic Requirements: Zone
   16. Hoistway Dimensions: 8'-3" wide x 10'-2" deep
      a. Note: Hoistway dimensions listed above are for Seismic Zone 1 only. If you have chosen a seismic zone other than zone 1 please consult your local TK Elevator Sales Representative for the proper hoistway dimensions.
   17. Pit Depth: 5'-0"
   18. Button & Fixture Style: Traditional Signal Fixtures
   19. Special Operations:
      Limited Access with card readers by others

A. Car 3 - Elevator Qty. 1
    1. Elevator Model: evolution 200
    2. Elevator Type: Gearless Traction Machine Room-Less, Passenger
    3. Rated Capacity: 5000 lbs.
    4. Rated Speed: 200 ft./min.
    5. Operation System: TAC32T
    6. Travel: 34'-0"
    7. Landings: 3 total
    8. Openings:
        a. Front: 3
        b. Rear: 0
    9. Clear Car Inside: 5'-8" wide x 8'-5" deep
    10. Inside clear height: 7'-4" standard
    11. Door clear height: 7'-0" standard
    12. Hoistway Entrance Size: 4'-6" wide x 7'-0" high
    13. Door Type: Two-speed | RH Side opening
    14. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
        a. Note: Isolation Transformer required for jobs with less than 480vac, 3 Phase building power.
    15. Seismic Requirements: Zone
    16. Hoistway Dimensions: 8'-3" wide x 10'-2" deep
        a. Note: Hoistway dimensions listed above are for Seismic Zone 1 only. If you have chosen a seismic zone other than zone 1 please consult your local TK Elevator Sales Representative for the proper hoistway dimensions.
    17. Pit Depth: 5'-0"
    18. Button & Fixture Style: Traditional Signal Fixtures
    19. Special Operations:
        Limited Access with card readers by others

B. Car 4 - Elevator Qty. 1
    1. Elevator Model: evolution 200
    2. Elevator Type: Gearless Traction Machine Room-Less, Passenger
    3. Rated Capacity: 2500 lbs.
    4. Rated Speed: 200 ft./min.
    5. Operation System: TAC32T
    6. Travel: 17'-0"
    7. Landings: 2 total
    8. Openings:
        a. Front: 2
        b. Rear: 0

9. Clear Car Inside: 6'-8" wide x 4'-3 3/8" deep
10. Inside clear height: 7'-4" standard
11. Door clear height: 7'-0" standard
12. Hoistway Entrance Size: 3'-6" wide x 7'-0" high
13. Door Type: One-speed Center opening
14. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
    a. Note: Isolation Transformer required for jobs with less than 480vac, 3 Phase building power.
15. Seismic Requirements: Zone
16. Hoistway Dimensions: 8'-6" wide x 5'-9" deep
    a. Note: Hoistway dimensions listed above are for Seismic Zone 1 only. If you have chosen a seismic zone other than zone 1 please consult your local TK Elevator Sales Representative for the proper hoistway dimensions.
17. Pit Depth: 5'-0"
18. Button & Fixture Style: Traditional Signal Fixtures
19. Special Operations: None

C. Car 5 - Elevator Qty. 1
1. Elevator Model: evolution 200
2. Elevator Type: Gearless Traction Machine Room-Less, Passenger
3. Rated Capacity: 2500 lbs.
4. Rated Speed: 200 ft./min.
5. Operation System: TAC32T
6. Travel: 34'-0"
7. Landings: 3 total
8. Openings:
    a. Front: 2
    b. Rear: 1
9. Clear Car Inside: 6'-8" wide x 4'-3 7/8" deep
10. Inside clear height: 7'-4" standard
11. Door clear height: 7'-0" standard
12. Hoistway Entrance Size: 3'-6" wide x 7'-0" high
13. Door Type: One-speed Center opening
14. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
    a. Note: Isolation Transformer required for jobs with less than 480vac, 3 Phase building power.
15. Seismic Requirements: Zone
16. Hoistway Dimensions: 8'-6" wide x 6'-8 3/8" deep
    a. Note: Hoistway dimensions listed above are for Seismic Zone 1 only. If you have chosen a seismic zone other than zone 1 please consult your local TK Elevator Sales Representative for the proper hoistway dimensions.
17. Pit Depth: 5'-0"
18. Button & Fixture Style: Traditional Signal Fixtures
19. Special Operations: None

3.09 SPECIAL CONDITIONS (Note: Add Special Conditions as Needed)

END OF SECTION

DIVISION

21

FIRE SUPPRESSION

SECTION 21 00 00 - FIRE PROTECTION SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED:

A. The General Conditions of the Contract and Supplementary Conditions of the Contract shall govern the work under this Section of the Specifications. The Contractor is specifically directed to refer to said conditions.

B. It is understood that these specifications, and the accompanying drawings, complement complete apparatus, fully erected and in successful operating condition. All work must be preformed in the best and most substantial manner.

C. These specifications are intended to provide complete, and in proper operation, all sprinkler system piping, equipment, heads, valves, controls, air compressor, and accessories, all as specified herein or shown on the accompanying drawings, or reasonably implied in either. The building shall be provided with complete coverage sprinkler system for the spaces designated on the drawings classification as required. System shall consist of a calculated dry system unless indicated otherwise. Verify all pertinent criteria. The systems shall conform to layout shown and meet all requirements of agencies listed under "REGULATIONS AND STANDARDS" below. Refer to plans and specifications for additional information.

D. Pipe, fittings, valves, and connections for fire protection and sprinkler systems shall be furnished by fire protection contractor.

1.2 RELATED WORK:

A. Section 21 13 13 - Wet-pipe Sprinkler Systems.

1.3 SYSTEM LAYOUT:

A. Where plans indicate layout of system components, the layout shall be verified to comply with "REGULATIONS AND STANDARDS" and shall be revised if required to comply. The location of the sprinkler system piping and components shall be coordinated with all other trades. Revisions to sprinkler system layout shall be at Sprinkler Contractor's expense. Any such revisions shall be verified with the Architect.

1.4 ELECTRICAL WORK

A. See 28 31 00 – Fire Alarm

1.5 SPRINKLER SYSTEM CONTRACTOR:

A. It is intended that the work under this section is to be preformed by a qualified Fire Protection Piping Systems Contractor regularly engaged in this type of work. The Contractor is to hold a current license to perform this work and be certified by the State Fire Marshall. All documents shall bear this certification.

1.6 REGULATIONS, STANDARDS AND REFERENCES:

A. It is the intention of these specifications and the accompanying drawings, that all elements and features of the fire protection system shall be in accordance with the standards of the National Fire Association (NFPA), the State Fire Marshall, all applicable building codes and Property Insurance Association of Louisiana whether so indicated or not. NFPA standards are on file in office of Engineer and may be examined at the Contractor's request.

B. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 150.

C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150. Interior of building.

D. Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.

E. NFPA 13 - Installation of Sprinkler Systems.

F. NFPA 14 - Standpipe and Hose Systems.

1.7 QUALITY ASSURANCE:

A. Conform to NFPA 13 for sprinkler systems.

B. Conform to NFPA 14 for standpipe hose systems.

C. Welding Materials and Procedures: Conform to ASME Code.

D. Employ certified welders in accordance with ANSI/ASME Section 9. AWS D10.9.

E. Valves: Bear UL FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.

1.8 SUBMITTALS:

A. Submit product data under provisions of section 01 33 00 – Submittal Procedures

B. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals.

C. Indicate valve data and ratings.

1.9 DELIVERY, STORAGE, AND HANDLING:

A. Deliver and store valves in shipping containers, with labeling in place, under provisions of Section 01 60 00– Materials and Equipment.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures. Maintain in place until installation.

D. Sprinkler piping shall be stored off the ground or floor with ends sealed to protect from debris.

1.10 AREAS SUBJECT TO FREEZING:

A. For areas requiring protection and not receiving direct heating during times of potential freezing, such as building overhangs, porches, canopies, attics, etc. provide a compressed air dry pipe system for these areas only, see drawings for locations. Coordinate electrical requirements with contractor.

1.11 MANUFACTURER'S OR TRADE NAMES:

A. Where the plans or specifications mention the names of manufacturers or the products of specific manufacturers, it is intended that the Contractor shall furnish the item or items as specifies. Products of manufacturers that are not mentioned shall be subject to prior review by the Engineer and shall in any case mentioned shall be subject to prior review by the Engineer and shall in any case be in accordance with regulations and standards as state above.

1.12 SHOP DRAWINGS AND SUBMITTAL DATA:

A. Within fifteen (15) days of award of the contract, the contractor shall submit one (1) copy of system piping shop drawings and one (1) copy of manufacturer's data and descriptive literature and drawings for all equipment and materials. Additionally, provide a reproducible (sepia) copy of the system piping shop drawings. All drawings, literature and data on all equipment shall be submitted at the same time; this material shall contain complete layout, capacity data, dimensions and other pertinent information necessary for the Architect to properly review and evaluate the item that necessary to meet the requirements for submittal to the State Fire Marshall.

B. The contractor shall obtain approval of agencies listed under "REGULATIONS AND STANDARDS" before submitting to the Engineer, except that the date for State Fire Marshall's review shall be submitted to the Engineer prior submitting to the Fire Marshall. All required review fees and applicable requirements shall be by the contractor. No item of equipment or material shall be place on order until Final Review comments have been received from the Architect. See "DRAWINGS" below.

1.13 ORDINANCES, RULES AND REGULATIONS:

A. All material and construction shall conform to the requirements of all building, plumbing and sanitary codes and laws in force in the locality in which the work is to be done. All materials and construction shall also conform to the rules and regulations listed above under "REGULATIONS AND STANDARDS".

1.14 DRAWINGS:

A. The contractor shall submit detailed drawings for all sprinkler system showing exact locations and sizes of all elements in the system before fabrication is begun. Engineer shall have the prerogative of changing the position or configuration of these systems without changing the total scope of work involved to comply with "Regulations And Standards".

1.15 GUARANTEE:

A. The contractor shall guarantee all materials and workmanship under this contract for a period of one (1) year from date of final acceptance of his work and shall repair or replace any such defective materials and workmanship without cost to the Owner.

B. The guarantee shall include complete service, including adjustment service and inspection, during the guarantee period as required by local codes and regulations.

1.16 APPROVAL OF PRODUCT PRIOR TO BIDDING

A. Refer to Instructions to Bidders

PART 2 PRODUCTS

2.1 PIPE AND TUBE:

A. See Section – 21 13 13 Wet-pipe Sprinkler System

B. Underground pipe shall be C900 to within 5' of building.

2.2 PIPE FITTINGS:

A. Steel Fittings: ANSI/ASME B16.9, wrought steel, butt welded. ANSI/ASME B16.25, buttweld ends. ASTM A234, wrought carbon steel and alloy steel. ANSI/ASME B16.5,steel flanges and fittings. ANSI/ASME B16.11, forges steel socket welded and threaded.

B. Cast Iron Fittings: ANSI/ASME B16.1,flanges and fittings. B16.4, screwed fittings.

C. Malleable Iron Fittings: ANSI/ASME B16.3, screwed type. ANSI/ASTM A47.

D. All piping and fittings in PDDC areas must be schedule 40 galvanized steel piping.

2.3 JOINT MATERIALS:

A. Solder: ANSI/ASTM B32, 95/5 alloy.

B. Brazing: ANSI/AWS A5.8.

C. Threaded Joint Compound.

2.4 UNIONS, FLANGES, AND COUPLINGS:

A. Unions: 150 psi malleable iron for threaded ferrous piping.

B. Flanges: 150 psi forges steel slip-on flanges for ferrous piping.

2.5 ACCEPTABLE MANUFACTURER - GATE VALVES:

A. Nibco 637-31

B. Central 722 U Series

C. Substitutions: Under provisions of Instructions To Bidders.

2.6 GATE VALVES:

A. Bronze, rising stem, inside screw, solid wedge.

2.7 ACCEPTABLE MANUFACTURERS - GLOBE OR ANGLE VALVES:

A. Nibco GS-132-U

B. Crane 143

C. Substitutions: Under provisions of Instructions To Bidders.

2.8 GLOBE OR ANGLE VALVES:

A. Bronze, rising stem, inside screw, renewable composition disc.

2.9 ACCEPTABLE MANUFACTURERS - CHECK VALVES:

A. NIBCO CS-172

B. Crane 147

C. Substitutions: Under provisions of Instructions To Bidders.

2.10 CHECK VALVES:

A. Iron body, bronze trim, swing disc, renewable disc and seat.

2.11 ACCEPTABLE MANUFACTURERS - BUTTERFLY VALVES:

A. Nibco LD 3510-2 Series

B. Central Fig. 570 or 580

C. Substitutions: Under provisions of Instructions To Bidders.

2.12 BUTTERFLY VALVES:

A. Iron body, bronze stainless steel disc and stem extended for insulated work, resilient replaceable liner seat.

2.13 ACCEPTABLE MANUFACTURERS - DRAIN VALVES:

A. Nibco F-667-0 Series

B. Central 722 U Series

C. Substitutions: Under provisions of Instructions To Bidders.

2.14 DRAIN VALVES:

A. Brass ball valve with cap and chain, 3/4 inch (19 mm) hose thread.

2.15 VALVE OPERATORS:

A. Provide handwheels for gate, globe or angle, and drain valves.

B. For butterfly valves provide gear operators for sizes 8 inches and larger. For smaller sizes provide level lock handle with toothed plate.

2.16 VALVE CONNECTIONS:

A. Provide valve connections to match pipe joints. Use valves of pipe size.

B. For copper tube, provide threaded solder adapters for connection to valve.

C. Provide butterfly valve with tapped lug body when used for isolating service.

2.17 SIAMESE FIRE DEPARTMENT CONNECTIONS:

A. Provide two-way standard siamese fire department connection with chrome plated finish, local fire department threads, dust caps and chains, 3/4" automatic drip, marked "SPRINKLER - FIRE DEPARTMENT CONNECTION:.

2.18 ACCEPTABLE MANUFACTURERS - SPRINKLER HEADS:

A. Reliable Automatic Sprinkler

B. Viking Corp.

C. Tyco-Fire

D. Substitutions: Under provisions of Instruction To Bidders.

E. Sprinkler heads in any pool areas shall be corrosion resistant.

PART 3 INSTALLATION

3.1 GENERAL:

A. Furnish and install in a neat workmanlike manner, all piping shown on drawings or that is

specified or required to provide a complete, properly operating installation. All piping and accessories shall conform to standards as applicable.

B. Run piping parallel with the lines of the building, unless specifically shown or noted otherwise. All pipe, fittings, valves, etc., shall have sufficient clearance from other work to finish at least 1/2 inch from other work or finished covering of other piping.

C. Provide all necessary hangers, anchors, thrust blocks, etc., to properly support and protect piping system, as required by agencies listed under "REGULATIONS AND STANDARDS".

D. Under no circumstances is the contractor to attach to or support from any bar joist bridging. Any supports to the bar joists or any structural systems are to be approved by the Architect/Engineer. All supplement angle or channel iron required to support equipment of this Specification is to be furnished by the contractor and is to be independent of any other supports.

3.2 DESIGN:

A. The sprinkler systems shall be designed as required for occupancies specified by experienced personnel have competency in the execution of such work. Sprinkler system design shall be performed only by licensed sprinkler contractors.

B. Sprinkler piping shall be protected from freezing during the lay-a-way period.

C. NFPA rules and regulations governing the design shall be scrupulously adhered to.

D. Piping shall be installed in accordance with NFPA 13.

3.3 EXECUTION:

A. Run piping concealed above furred ceiling and in joists to minimize obstructions. Expose only heads.

B. Coordinate sprinkler piping routing and heads with all trades.

C. Protect sprinkler heads against mechanical injury.

D. Include all costs of shop drawings review and approval from authorities in price.

E. Locate outside alarm on wall of building adjacent to Siamese department connections.

F. Provide cabinet containing required number of spare heads as per NFPA 13, of each type, along with wrench suitable for each type of head.

G. Provide flow switch on leaving side of main valve and monitoring switch on main valve. Flow switch shall sense flow and sound appropriate zone of fire alarm system monitoring switch on each main valve; when valve is started to its "closed" position shall indicate trouble on appropriate zone of fire alarm system and sound local audible alarm. Wiring between flow switches and monitoring switches and fire alarm system shall be provided under the Electrical Division.

H. Furnish and install sprinkler zone valves and flow switches where indicated on the drawings for the zoning of the system. Each of these devices shall be connected into the fire alarm system as indicated for the main valve, including local alarming.

I. Provide all test and drain valves as required per NFPA 13.

J. Support sprinkler piping in accordance with NFPA 13.

K. Provide new water service as shown on the drawings.

L. Install air compressor on vibration isolators, as required.

M. Screw joint steel piping up to and including 1-1/2 inch diameter. Screw or Roll Goove 2 inch diameter and larger. PER NFPA 13.

N. Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

O. Coat threaded ends with pipe lubricant compound.

P. Steel piping, main sized saddle branch connections or direct connection of branch lines to mains is permitted if main is one pipe size larger than the branch for up to 6 inch mains and if main is two pipe sizes larger than branch for 8 inch and larger mains.

Q. Solder Braze copper tubes.

R. Install piping in accordance with NFPA 13 for sprinkler systems and NFPA 14 for standpipe and hose systems.

S. Do not penetrate building structural members unless indicated.

T. Provide sleeves when penetrating footings floors and walls.

U. Seal pipe and sleeve penetration to achieve fire resistance equivalent to fire separation required.

3.4 INSTALLATION - VALVES:

A. Install valves with stems upright or horizontal, not inverted.

B. Provide gate valves for shut-off or isolating service.

C. Where approved, butterfly valves may be used instead of gate valves.

D. Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.5 SLEEVES AND PLATES:

A. Wherever pipes pass through concrete slabs, furnish and install sleeves, properly located for the work.

B. Use sleeves of sufficient size to allow the specified pipe covering to pass through the sleeves and finish sleeves flush with walls and ceiling.

C. Sleeves shall be galvanized steel not lighter than 24 gauge.

D. Seal spaces between sleeve and pipe. Use packing device or material for UL rating to match rating of wall or floor/ceiling as rated under UL File R9658.

3.6 ESCUTCHEONS:

A. Where pipes passing through floors, walls or ceiling exposed to view in finished areas, provide pressed steel split plates which cover the opening and fit snugly to pipe.

3.7 COORDINATION:

A. All interlock and signal wiring runs to the annunciator panel will be furnished and installed

and as part of the Electrical Work.

B. This contractor shall provide for all switches and interlocking devices on all valves as required.

3.8 UNDERGROUND PIPING:

A. Underground fire protection system piping shall be installed in accordance with the requirements of NFPA 24, Private Fire Service Mains and Their Appurtenances. Provide concrete thrust blocking at each change of direction of the piping and at all tees, plugs, and caps in accordance with NFPA 24. Where thrust blocking is impractical, fittings with a mechanical joint retainer gland, approved for the piping material utilized, may be used in lieu of thrust blocking.

END OF SECTION 21 00 00

SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Installation of new sprinkler and related piping systems in new construction.

1.2 WORK INSTALLED BUT SPECIFIED UNDER OTHER SECTIONS

A. Section Fire Protection Piping: Piping and valves.

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves to General Contractor.

1.4 RELATED WORK

A. Section 23 05 29 - Supports and Anchors.

1.5 REFERENCES:

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volt maximum).

B. NFPA 13 - Installation of Sprinkler Systems.

1.6 SYSTEM DESCRIPTION:

A. System to provide coverage for entire new building area.

B. Interface system with building control system. Building fire and smoke alarm system.

C. Provide system per NFPA 13 hazard requirement.

1.7 QUALITY ASSURANCE:

A. Design and installation to conform to NFPA 13.

B. Equipment and components: Bear UL FM label or marking.

C. Specialist Firm: Company specializing and licensed in sprinkler systems.

1.8 REGULATORY REQUIREMENTS:

A. Hydraulic Calculations, Product Data, Shop Drawings: Bear stamp of approval of Fire Marshal.

B. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories.

C. Submit shop drawings product data hydraulic calculations to Fire Marshal. Submit proof of approval to Architect. Include check for review fee with submittal to Fire Marshal's office.

1.9 PROJECT RECORD DOCUMENTS:

A. Submit documents under provisions of Section 01 78 39.

1.10 OPERATION AND MAINTENANCE DATA:

A. Submit manufacturer's operation and maintenance data under provisions of Section 01 78 23.

B. Include written maintenance data on components of system, servicing requirements, and record drawings.

C. Include maintenance, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.11 DELIVERY, STORAGE, AND HANDLING:

A. Deliver and store materials in shipping containers with labeling place under provisions of Section 01 60 00 – Materials and Equipment .

B. Provide suitable wrenches for each head type.

C. Maintain caps in place until installation.

D. Sprinkler piping shall be stored off the ground or floor with ends sealed to protect from debris.

1.12 EXTRA STOCK:

A. Provide extra sprinkler heads under provisions of NFPA 13.

B. Provide suitable wrenches for each head type.

C. Provide storage cabinet, size and type as per NFPA-13 – See 21 00 00 Fire Protection

PART 2 PRODUCTS

2.1 PIPING MATERIALS:

A. Above Ground Inside Building Piping: Pipe diameter smaller than and up to 2" shall be Steel Schedule 40 pipe, Pipe diameters 2-1/2" and larger shall be Steel Schedule 10 or Steel Schedule 40 pipe, As permitted by NFPA 13.

B. All piping in pool areas shall be scheduled 40 galvanized steel PBing and fittings

2.2 ACCEPTABLE MANUFACTURERS - SPRINKLER HEADS:

A. Reliable Automatic Sprinkler

B. Viking Corp.

C. Tyco-Fire

D. Substitutions: Under provisions of Instruction To Bidders.

E. All sprinkler heads in pool areas shall be corrosion resistive.

2.3 SPRINKLER HEADS:

A. Exposed Area Type: Standard upright type with brass finish.

B. Sidewall Type: Brass Chrome plated finish with matching escutcheon.

C. Fusible Link: Temperature rated for specific area hazard.

D. Guards: finish to match sprinkler head.

E. Finished ceilings: Pendent sprinklers - concealed type with white cover plates. Unless otherwise noted on plans.

PART 3 EXECUTION

3.1 PREPARATION:

A. Place pipe runs to minimize obstruction to other work.

3.2 INSTALLATION:

A. Run piping concealed above furred ceiling and in joists to minimize obstructions. Expose only heads.

B. Coordinate sprinkler piping routing and heads with all trades.

C. Protect sprinkler heads against mechanical injury.

D. Include all costs of shop drawings review and approval from authorities in price.

E. Locate outside alarm on wall of building adjacent to siamese fire department connections.

F. Provide cabinet containing required number of spare heads as per NFPA 13, of each type, along with wrench suitable for each type of head.

G. Provide flow switch on leaving side of main valve and monitoring switch on main valve. Flow switch shall sense flow and sound appropriate zone of fire alarm system monitoring switch on each main valve; when valve is started to its "closed" position shall indicate trouble on appropriate zone of fire alarm system and sound local audible alarm. Wiring between flow switches and monitoring switches and fire alarm system shall be provided under electrical division.

H. Furnish and install sprinkler zone valves and flow switches where indicated on the drawings for the zoning of the system. Each of these devices shall be connected into the fire alarm system as indicated for the main valve, including local alarming.

I. Provide all test and drain valves as required for system per NFPA 13.

J. Support sprinkler piping in accordance with NFPA 13.

K. Provide new water service as shown on the drawings.

3.3 CLEANING:

A. Flush entire piping system of foreign matter.

3.4 SYSTEM TESTS:

A. Hydrostatically test entire system.

B. Test shall be witnessed by Fire Marshal and Architect.

C. Test shall be witnessed by commissioning agent.

END OF SECTION 21 13 13

SECTION 21 30 00 - FIRE PUMP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire pump and controller.

B. Jockey pump.

1.2 RELATED WORK

A. Section 21 00 00 - Fire Protection System

B. Section 21 13 13 - Wet-Pipe Sprinkler System

1.3 REFERENCES

A. NFPA Pamphlet 20.

1.4 QUALITY ASSURANCE

A. Fire pump, jockey pumps and controller shall be by one manufacturer and shall be listed by Underwriters Laboratories, and approved by Factory Mutual Fire Insurance Companies.

B. Acceptable Manufacturers

1.5 SUBMITTAL

A. Aurora

B. Peerless

C. Submit product data under provisions of Section 01 33 00 – Submittal Procedures.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

1.7 APPROVAL OF PRODUCT PRIOR TO BIDDING

A. Refer to Section 01 60 00 –Material and Equipment, Material and Equipment for product prior approval requirements.

PART 2 PRODUCTS

2.1 FIRE PUMP

A. Furnish and install a complete fire pump system with pump, driver, controller, jockey pump and all accessories. The fire pump shall meet all requirements of NFPA and be fully approved by Factory Mutual Fire Insurance Company. ***400 GPM***

B. The fire pump shall be a horizontal, base mounted, split case, single stage, double suction centrifugal type.

C. The driver shall be a horizontal, foot mounted, open drip-proof, ball bearing type, AC, induction, squirrel cage motor ***25*** HP, 460/3ph/60, ***60*** psi. The motor shall be of such capacity that 115% of the full load ampere rating shall not be exceeded at any pump load for U.L. listed fire pump systems. Locked rotor current shall not exceed the values listed in

NFPA 20.

D. Pump and motor shall be mounted on a common base plate.

E. Impellers shall be enclosed type, cast bronze. Impellers shall be dynamically balanced, keyed to shaft and held in place with thread shaft sleeves. Pump shaft shall be made of SAE 1045 steel or equal. All pumps where the suction is expected 40 psi or below shall be provided with lantern ring connected to pressure side of the pump.

F. The fire pump unit shall be provided with the following accessories:
1. Eccentric tapered suction reducer.
2. Concentric tapered discharge increaser.
3. Hose valves.
4. Caps and chains.
5. Hose valve header.
6. Pressure gauges.
7. Circulation relief valve.
8. Automatic air release valve.
9. Coupling guard.

2.2 FIRE PUMP CONTROLLER

A. The fire pump controller shall be U.L. listed and FM approved. It shall be completely assembled and wired and tested at factory. The controller shall be locked as not to be water damaged and shall be of the combination manual/automatic type. The controller shall be primary resistor type complete with the following accessories:
1. Disconnect switch and auto transfer switch.
2. Circuit breaker - time delay type with trips in all phases set for 300% of motor full load current interrupting capacity - 100,000.
3. Motor starter.
4. Pressure switch.
5. Running period timer.
6. Pilot light.
7. Ammeter.
8. Alarm relay with audible alarm.
9. Manual selection station marked "automatic" - "non-automatic".
10. Means shall be provided on the controller to operate an alarm signal continuously while pump is running.
11. All control equipment shall meet requirements of NFPA 20.
12. Tests: The pump and electric motor shall be shop tested and meet NFPA 20, the pump shall be given a complete performance test with positive suction pressure. A certified performance curve shall be prepared and submitted. Pumps shall also be hydrostatically tested to twice shut-off head. The pump manufacturer shall assume unit responsibility and shall provide the services of a factory trained representative to supervise and/or be available to conduct final field test.

2.3 JOCKEY PUMP

A. Furnish and install where indicated on drawings an in-line close coupled jockey pump.

B. Pump shall have the following capacities: 10 GPM, at ***50*** psi, 3 HP, 3500 RPM, 480/3ph/60.

C. Acceptable Manufacturers
1. Aurora
2. Grundfos

END OF SECTION 21 30 00

DIVISION

22

PLUMBING

SECTION 22 10 00 - PLUMBING PIPING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Pipe and Pipe Fittings

B. Valves

C. Sanitary Sewer Piping System

D. Domestic Water Piping system

E. Service Connections

F. Natural Gas Piping System

1.2 RELATED WORK

A. Section 23 00 00 - General Provisions

B. Section 23 05 16 - Expansion Compensation

C. Section 23 05 23 - Supports and Anchors

D. Section 23 07 00 – Piping and equipment Insulation

E. Section 22 10 10 - Plumbing Specialties

F. Section 22 40 00 - Plumbing Fixtures

1.3 REFERENCES:

A. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.

B. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

C. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

D. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.

E. ANSI/ASTM B32 - Solder Metal.

F. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

H. ASTM A74 - Cast Iron Soil Pipe and Fittings.

I. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

J. ASTM B88 - Seamless Copper Water Tube.

K. ASTM B306 - Copper Drainage Tube (DWV).

L. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

M. AWS A5.8 - Brazing Filler Metal.

N. AWWA C601 - Standard Methods for the Examination of Water and Waste Water.

O. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary System.

P. CISPI 310 – Standard for cast iron couplings

Q. LSPC – The latest addition of the Louisiana State Plumbing Code.

1.4 QUALITY ASSURANCE:

A. Valves: Manufacturer's name and pressure rating market on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec. 9. ANSI/AWS D 1.1.

D. Cast iron pipe and fittings shall be marked with CISPI's collective trademark.

1.5 SUBMITTALS:

A. Submit shop drawings and product data under provisions of Section 01 30 00.

B. Include data on pipe material, pipe fittings, valves and accessories.

1.6 WATER PIPE AND FITTING MATERIALS STANDARD

A. Plastic Water Pipe and Fittings
1. ABS and PVC Plastic Tubular Fittings: ASTM F 409, ANSI/NSF 24, ANSI/NSF 14
2. Joints for IPS PVC pipe using solvent cement: ASTM D 2672
3. Chlorinated poly (vinyl chloride) (CPVC) plastic pipe, Schedule 80, 2" and under: ASTM F 441, listed
4. Chlorinated poly (vinyl chloride) (CPVC) plastic pipe (SDR-PR): ASTM F 442
5. CPVC Pipe and fittings: ASTM D 2846, Listed
6. Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) pressure pipe and fittings: ASTM F 1281
7. Cross-linked Polyethylene (PEX) plastic hot and cold water distribution system: ASTM F 877, Listed
8. Cross-linked Polyethylene (PEX) tubing: ASTM F 876
9. Cross-linked Polyethylene (PEX) tubing systems for pressure: CAN/CSA-B137.5M89, listed
10. Flexible Elastomeric pressure joints: ASTM D 3139, See 308.8
11. Metal insert fittings for PB tubing: ASTM F 1380
12. Polyethylene/Aluminum/Polyethylene (PE-AL-PE) pressure pipe and fittings: ASTM F 1282
13. Polyethylene pipe and tubing (PE) Number 2305, 2306, 3306, 3406, 3408: ASTM D 2104, ASTM D 2239, ASTM D 2737, Listed, See 303.8.2
14. Poly (vinyl chloride) (PVC) plastic pipe fittings, Schedule 40: ASTM D 2466
15. Pressure rated ABS-fittings: ASTM D 2468, Listed
16. Pressure rated ABS-pipe Number 1210, 2112, 1316: ASTM D 1527, ASTM D 2282, Listed, See 303.8.2
17. PVC injection molded gasketed fittings for pressure applications: CAN/CSA-B137.2-M89, Listed
18. PVC Pipe, Number 1120, 1220: ASTM D 1785, ASTM D 2241, listed, See 303.8.2

19. PVC socket-type fittings, Schedule 80: ASTM D 2467, listed
20. Socket-type chlorinated poly (vinyl chloride) (CPVC) plastic pipe fittings, Schedule 80, 2” and under: ASTM F 439, listed
21. Threaded chlorinated poly (vinyl chloride) (CPVC) plastic pipe fittings, Schedule 80, 2” and under: ASTM F 437, listed

B. Ferrous Water Pipe and Fittings
1. Cast Iron fittings (threaded): ASTM A 126
2. Cast iron pipe (threaded): ANSI A40.5
3. Cast iron water pipe: ASTM A377
4. Ductile-iron water pipe: ANSI/AWWA C 151/A 21.51
5. Ductile-iron water fittings: ANSI/AWWA C 110/A 21.10
6. Malleable iron fittings (threaded): ASTM A 197
7. Nipples pipe (threaded): FS WW-N-351a
8. Stainless steel water pipe Grade H: ASTM A 268, See 303.8.4
9. Steel couplings, threaded, black and galvanized: ASTM A 865
10. Steel pipe black and galvanized: ASTM A 53
11. Welded and seamless steel pipe: ASTM A 53

C. NonFerrous Pipe and Fittings
1. Cast bronze fittings for flared copper tube: ANSI B16.26
2. Cast bronze threaded fittings: ASME B16.15
3. Cast bronze solder-joint pressure fittings: ANSI B16.18
4. Cast copper alloy fittings for flared copper tubes: ASME B 16.26
5. Pipe flanges and flanged fittings: ANSI B16.5
6. Seamless brass tube: ASTM B 135
7. Seamless copper pipe: ASTM B 42
8. Seamless copper tube: ASTM B 75
9. Seamless copper water tube types K, L, & M: ASTM B 88
10. Seamless red brass pipe: ASTM B 43
11. Seamless and welded copper distribution tube (type D): ASTM B 641
12. Threadless copper pipe (TP): ASTM B 302
13. Welded brass tube: ASTM B 587
14. Welded copper tube: ASTM B 447
15. Welded copper alloy UNS # C21000 water tube: ASTM B 642
16. Wrought copper and copper-alloy solder-joint pressure fittings: ASME B 16.22 for copper water tube
17. Wrought seamless copper and rectangular copper-alloy pipe and tube: ASTM B 251, square and tubing not applicable
18. Valves-flanged threaded, and welding end: ANSI B 16.34

D. Backflow Prevention Devices Materials Standard
1. Air gap standards: ASME A112.1.2
2. Backflow preventers, double check valve assembly: ASSE 1015, ANSI/AWWA C510
3. Backflow preventers with intermediate atmospheric vent: ANSI/ASSE 1012
4. Backflow preventers, double check detector assembly: ANSI/ASSE 1048
5. Backflow preventers, hose connection: ANSI/ASSE 1052
6. Backflow preventers, reduced pressure detector assembly: ANSI/ASSE 1047
7. Backflow preventers, reduced pressure principle assembly: ANSI/AWWA C511, ASSE 1013
8. Dual check valve type backflow preventer: ASSE 1032, for carbonated beverage dispensers-post mix type
9. Field test procedures for backflow preventer assemblies: ASSE 5010
10. Manual for the selection, installation, maintenance, and field testing of backflow prevention devices: CAN/CSA B64.10
11. Vacuum breakers, Anti-Siphon, pressure type assembly (outdoor use): ASSE 1020

12. Vacuum breakers-atmospheric pipe applied: ANSI/ASSE 1001
13. Vacuum breakers, back siphonage, pressure type assembly (spill resistant): ANSI/ASSE 1056
14. Vacuum breakers, hose connections: ANSI/ASSE 1011
15. Vacuum breakers, laboratory faucet: ANSI/ASSE 1035
16. Vacuum breaker wall hydrants, fronts resistant automatic draining: ASSE 1019
17. Water closet flush tank fill valves (ballcocks): ASSE 1002

E. Valves Material Standards
1. Valves, ball: MSS SP-72, MSS SP-110

F. Temperature Control Device Standards
1. Individual shower control valves, anti-scald: ASSE 1016
2. Temperature actuated mixing valves for primary domestic use: ASSE 1017
3. Water supply valves, mixing valves and single control mixing valves: ASSE 1029

G. Potable Water Piping
1. All potable water pipes, pipe related products, and materials that join of seal pipes conform to ANSI/NSF 61.

1.7 DRAINAGE SYSTEM MATERIALS STANDARDS

A. NonMetallic Piping
1. Concrete drain tile: ASTM C 412
2. Concrete perforated: ASTM C 444
3. Concrete reinforced culverts: ASTM C 76, for storm drains only
4. Concrete reinforced sewer pipe: ASTM C 361, for storm drains only
5. Concrete sewer pipe: ASTM C 14, for storm drains only
6. Sewer manholes: ASTM C 478
7. Concrete (steel cylinder type): FS SS-P-381

B. Plastic Pipe and Fittings
1. Coextruded composite pipe: ASTM F 1488, See 303.8.3, 303.8.5, 704.1, 1101.5, 1103.2, 1103.4
2. Coextruded composite drain, waste, and vent pipe (DWV): ASTM F 1499, See 303.8.3, 303.8.5, 704.1, 1101.5, 1103.2, 1103.4
3. Coextruded PVC plastic pipe: ASTM F 891, See 303.8.3, 303.8.5, 704.1, 1101.5, 1103.2, 1103.4
4. Flexible elastomeric non-pressure joints: ASTM D 3212, See 303.8
5. Large diameter ribbed PVC sewer pipe and fittings: CAN/CSA-B182.4
6. Polyolefin laboratory drainage systems: CAN/CSA-B181.3
7. PVC-DWV pipe and fittings: ASTM D 2665, listed, See 303.8.3
8. Type PS 46 and type PS 115 sewer pipe (for outside building sewers, storm drains): ASTM F 789, See 704.1, 1101.4, 1103.2, 1103.4, ASTM D 2321, installation
9. Type PSM PVC sewer pipe and fittings (for outside building sewers, storm drains, and storm sewers): ASTM 3034, See 704.1, 1101.5, 1103.2, 1103.4, ASTM D 2321, installation
10. Type PSP PVC sewer pipe and fittings (for outside building sewers, storm drains, and storm sewers): ASTM D 2321, Installation
11. All plastic piping pipes, plastic plumbing piping components and related materials shall be listed as conforming with ANSI/NSF Standard 14.

C. Ferrous Pipe and Fittings
1. Cast iron soil pipe and fittings: ASTM A 74, CISPI HS
2. CI NO-HUB pipe and fittings: ASTM A 888, CISPI Std. 301
3. Ductile-iron gravity sewer pipe: ASTM A 746
4. Hubless cast iron sanitary system: CISPI Std. 310

5. Manhole top frames and covers: ASTM A 48

D. NonFerrous Pipe and Fittings
1. Cast copper alloy solder-joint drainage fittings: ASME B 16.23, for plumbing drainage waste and vents
2. Cast copper alloy solder-joint fittings for solvent drainage systems: ANSI B 16.32
3. Copper drainage tube DWV: ASTM B 306
4. Welded copper and copper alloy heat exchanger tube: ASTM B 543
5. Wrought copper and wrought copper alloy solder-joint drainage fittings for plumbing drainage waste and vents: ASME B 16.29
6. Wrought copper and wrought copper alloy solder-joint fittings for solvent drainage systems: ANSI B 16.43

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING AND STORM SEWER - BURIED BEYOND 5 FEET OF BUILDING:

A. Schedule 40 PVC/DWV
Fittings: Same as piping
Joints: Solvent welded

2.2 SANITARY SEWER AND STORM SEWER PIPING - BURIED WITHIN 5 FEET OF BUILDING:

A. Cast Iron Pipe: ASTM A74, service weight.
Fittings: Cast Iron.
Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
Fittings: Cast Iron.
Joints: CISPI 310 neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. All sanitary sewer piping in pool shall be schedule 40 PVC.

D. All underground piping shall be supported every 5’ and 1’ from each elbow by a stainless steel clevis hanger that is tied to the structural slab via a stainless steel threaded rod.

2.3 SANITARY SEWER AND STORM SEWER PIPING, ABOVE GRADE:

A. Cast Iron Pipe: ASTM A74, service weight.
Fittings: Cast Iron.
Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
Fittings: Cast Iron.
Joints: CISPI 310 neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. All sanitary sewer piping in pool shall be schedule 40 PVC.

2.4 WATER PIPING, ABOVE GRADE: Exterior water piping buried beyond 5' of building to be schedule 40 PVC.

A. Copper Tubing: ASTM B88, Type L, hard drawn.
Fittings: ANSI/ASME B16.18, cast bronze solder-joint pressure fittings, or ANSI/ASME B16.22, wrought copper.

B. All potable water pipes, pipe related products and materials that join or seal pipes and pipe related products shall be evaluated and listed as conforming with a national consensus

product or material standard and ANSI/NSF Standard 61.

2.5 WATER PIPING, TRAP PRIMERS: Piping for trap primer piping below slab only.

A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.

2.6 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING:

A. Polyethylene Pipe: ASTM D2513, SDR 11.5.
Fittings: ASTM D2683 to ASTM D2513, socket type.
Joints: Fusion welded.

2.7 NATURAL GAS PIPING, ABOVE GRADE:

A. Steel Pipe: ASTM A53 or A120, Schedule 40, black.
Fittings: ANSI/ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
Joints: Screwed for pipe two (2) inches and under; ANSI/AWS D1.1 welded, for pipe over two (2) inches. All gas piping run in a concealed space shall be welded.
B. All exterior gas pipe shall be painted safety yellow and tagged.

2.8 FLANGES, UNION, AND COUPLINGS:

A. Pipe Size two (2) Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, solder joints.

B. Pipe Size Over two (2) Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service.

C. Dielectric Connections: Unions with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.9 BALL VALVES:

A. Up to 2 Inches: Bronze or stainless steel body, stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, solder threaded ends with union. Nibco Model 580 Series, Crane Model 2330 Series, Red White 5092/5095 or approved equal.

B. Over 2 inches: Cast steel body, chrome plated steel ball teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10 inches and over, flanged.

C. All potable water isolation valves shall be S.S. Ball valves.

D. Water hamper arestors shall be installed on all domestic cold and hot water batteries and where required by the IBC.

2.10 BUTTERFLY VALVES:

A. Iron body, bronze disc, resilient replaceable seat for service to 180-degrees F, or lug end butterfly, 10 position over handle or infinite position lever handle with memory stop.

2.11 SWING CHECK VALVES:

A. Up to 2 inches: Bronze 45 degree swing disc, solder or screwed ends. Nibco Model 413 Series, Crane Model 37 Series, Red White 236/237 or approved equal.

B. Over 2 inches: Iron body, bronze trim, 45 degrees swing disc, renewable disc and seat, flanged ends. Red White 435, Nibco F918, Crane 373 or approved equal.

2.12 SPRING LOADED CHECK VALVES:

A. Iron body, bronze trim, spring loaded, bronze disc, wafer.

B. Red White 442, Nibco W920W, Stockham W6-970 or approved equal.

PART 3 EXECUTION

3.1 PREPARATION:

A. Ream pipe and tube ends. Remove burrs. Bevel end Ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATIONS:

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Route piping in orderly manner and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed.

H. Slope water piping and arrange to drain at low points.

I. Establish elevations of buried piping outside the building to insure not less than 3 feet of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.

L. Establish invert elevations, slope all drainage piping 4 inches and larger to 1/8 inch per foot minimum. All drainage piping 3 inches and smaller shall be sloped to 1/4 inch per foot minimum.

M. Install bell and spigot pipe with bell end upstream.

N. Install valves with stems upright or horizontal, not inverted.

O. Provide one plug cock wrench for every ten plug cocks sized 2 inches and smaller, minimum of one. Provide one plug cock wrench for each plug cock sized 2-1/2 inches and larger.

P. In pipe 3 – inch nominal diameter of less, cleanouts shall be located at not more than 50ft.intervals

Q. In pipe 4 – inches nominal diameter through 6 inches nominal diameter, cleanouts shall be located at not more than 80ft. intervals

R. Each building drain shall be provided with a cleanout within 6ft. of the junction of the building

drain and building sewer.

S. All plumbing piping shall be installed in a manner to freeze protect.

3.3 APPLICATION:

A. Grooved mechanical couplings and fasteners not allowed.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe. All joints in potable lines to be lead free.

D. Install ball, butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install ball, butterfly valves for throttling, bypass, or manual flow control services.

F. Provide spring loaded check valves on discharge of water pumps.

3.4 TEST

A. Upon completion of the domestic water piping system, The system shall be tested and proved tight under a water pressure not less than 200 psi. The water used for testing shall be obtained from a potable source of supply. This pressure test shall be performed before the disinfection of the domestic water piping system is started. This test shall conform to the Louisiana State Plumbing Code

B. Upon completion of the sanitary sewer piping system the contractor shall perform a water test to prove that the system is tight and with out leaks. No section of the piping system shall be tested with less than 10 ft head of water. The pressure shall be kept on the system for a time no less that 1 hour. This test shall conform to the Louisiana State Plumbing Code.

C. Upon completion of the sanitary vent piping system the contractor shall perform a pressure test to prove that the system is tight and is with out leaks. This test shall conform to the Louisiana State Plumbing Code.

D. All Gas piping shall be tested in accordance to NFPA 54.

E. Prior to any test, the Contractor shall notify the Architect in writing a minimum of 5 business days, the date and time the test will take place. No exceptions. After the completion of the test but before the building is substantially complete the contractor shall submit a written report with the following information for each test performed.
   1. Project Name
   2. Project Location
   3. Plumbing Contractor Name, Address and Contact Information
   4. Identification of test performed.
   5. Time and Date test was started
   6. Time and Date test was completed.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM:

A. Prior to starting work, verify system is complete, flushed and clean.

B. New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority or water purveyor having jurisdiction or, in the absence of a prescribed method, the procedure described in either AWWA C651 or AWWA C652, or as described in this section.

This requirement shall apply to “onsite or in-plant” fabrication of a system or to a modular portion of a system.

1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
2. The system or part thereof shall be filled with a water/chlorine solution containing not less than 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing not less than 200 parts per million (200 mg/L) of chlorine and allowed to stand for 3 hours.
3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

C. Prior to the disinfection of the domestic water piping system the contractor shall inform the architect in writing the date and time the disinfection will take place. After the completion of the disinfection of the domestic water piping system but before the building is substantially completed the contractor shall submit a written report with the following information.

1. Project Name
2. Project Location
3. Plumbing Contractors Name, Address, and contact information
4. Chemicals used in the disinfection process.
5. Time and Date disinfection process was started
6. Time and Date disinfection process was completed

3.6 SERVICE CONNECTIONS:

A. Provide new sanitary and storm sewer services and tie as shown on plans. Re: Civil Before commencing work check invert elevations required for sewer connections, confirm inverts and insure that these can be properly connected with slope for drainage and cover to avoid freezing. Contractor to tie in existing services as shown on drawings.

B. Tie domestic water services as shown on drawings. Re: Civil Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Provide 18-gauge galvanized sheet metal sleeve around service main to 6 inches above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing. Contractor shall utilize and tie in existing water lines as indicated on the drawings.

C. Tie new gas service Re: Civil. Coordinate connection with gas service provider.

END OF SECTION 21 10 00

SECTION 22 10 10 - PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Floor drains

B. Trap Primers

C. Cleanouts

D. Backflow preventors

E. Water hammer arrestors

F. Hose bibbs hydrants

1.2 RELATED WORK

A. Section 23 05 29 - Supports and Anchors

B. Section 22 10 00 - Plumbing Piping

C. Section 22 40 00 - Plumbing Fixtures

1.3 REFERENCES

A. ANSI/ASSE 1012 - Backflow Preventers with immediate Atmospheric Cent.

B. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

D. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

E. ANSI A112.21.1 - Roof Drains

F. ANSI A112.26.1 - Water Hammer Arrestors

G. PDI WH-201 Water Hammer Arrestors

1.4 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Include component sizes, rough-in requirements, service sizes, and finishes.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

A. Floor Drain (FD): ANSI A112.21.1; lacquered cast iron two piece body with double drainage

flange, weep holes, reversible clamping collar, square adjustable nickel- bonze strainer, and trap primer connection; Wade model 1100G, Zurn model Z415s or Smith model 2005.

B. All floor drains installed shall have trap primers.

C. All floor drains and trench drains in pool areas shall be hope heavy duty bodies and covers. Must be suitable for forklift traffic.

2.2 TRAP PRIMERS

A. Trap primers shall be PPP, Inc. Prime-Rite 500 with AG-500 air gap fitting. Distribution unit may be used for multiple floor drains. Trap primers shall be installed as per manufacturer recommendations and in strict accordance with the Louisiana Plumbing Code. Elastomeric flexible type trap guards will not be allowed on this project.

2.3 ROOF DRAINS

A. Roof Drains (RD): Duco Cast Iron body with adjustable extension sleeve, reversible collar, combined flashing clamp, under deck clamp, and gravel stop, with cast iron dome. Coordinate outlet with storm sewer piping. Wade model 3000-ADF, Zurn model Z100, or Smith model 1015.

2.4 EMERGENCY ROOF DRAIN

A. Emergency roof drain (ERD): Duco cast iron body with adjustable extension sleeve, 2” high combination membrane flashing clamp/gravel guard with cast iron dome drain. Coordinate outlet size with storm sewer piping. Zurn Z-100, Wade, or Smith.

2.5 FLOOR SINK

A. Floor sink (FS): 12”x12” floor sink with square nickel bronze top, 8” deep, aluminum dome strainer. Zurn Z1901, Wade 9144, or Smith 300.

2.6 CLEANOUTS

A. Exterior Surfaced Areas: As detailed on Plans.

B. Interior Finished Floor Areas: Lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and adjustable nickel- bronze strainer, square with scoriated cover in service areas and square with depressed cover to accept floor finish in finished floor areas; Model W-6000 manufactured by Wade or Model ZN-1400 manufactured by Zurn or 4000 Series manufactured by Smith.

C. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketted cover, and round stainless steel access cover secured with stainless steel machine screw; Model W-8460-R manufactured by Wade or Model ZN-1445-1 manufactured by Zurn or Model 4532 manufactured by Smith.

D. Interior Unfinished Accessible Areas: Caulked or threaded type, provide bolted stack cleanouts on vertical rainwater leaders.

E. Acceptable Manufacturers
1. Wade 6000
2. Zurn 1400
3. Substitutions: Under provisions of Instructions To Bidders.

2.7 BACKFLOW PREVENTERS

A. Pressure Backflow Preventers: ANSI/ASSE 1013;bronze body with bronze and plastic internal parts and Stainless steel springs; two independently operating,spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

B. Acceptable Manufacturers
   1. Watts Model 909
   2. Wilkins Model 375
   3. Substitutions: Under provisions of Instructions To Bidders.

2.8 REDUCED-PRESSURE-DETECTOR, FIRE-PROTECTION, BACKFLOW-PREVENTER ASSEMBLIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Ames Fire & Waterworks; a Watts Water Technologies Company
   2. FEBCO; a Watts Water Technologies Company
   3. Watts Regulator; a Watts Water Technologies Company
   4. Substitutions: Under provisions of Instructions To Bidders

B. Standard: ASSE 1047 and is FM Global approved or UL listed.

C. Operation: Continuous-pressure applications.

D. Pressure Loss: 12 psig maximum, through middle third of flow range.

E. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved.

F. End Connections: Flanged.

G. Configuration: Designed for vertical-inlet, horizontal-center-section, and vertical-outlet flow.

H. Accessories:
   1. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
   2. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
   3. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.9 WATER HAMMER ARRESTORS

A. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged suitable for operation in temperature range - 100 to 300 degrees F (-73 to 49 Degrees C) and maximum 250 psig (1700 kpa) working pressure.

B. Acceptable Manufactures
   1. Wade Model W-5, W-10, W-20
   2. Zurn Model Z-1700-100, 200, 300
   3. Smith Model 5000
   4. Substitutions: Under provisions of Instructions To Bidders.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate cutting forming of roof/floor construction to receive drains to required invert elevations.

3.2 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to permit intended performance.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Insure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install water hammer arrestors complete with accessible isolation valve.

E. In pipe 3 – inch nominal diameter of less, cleanouts shall be located at not more than 50ft.intervals

F. In pipe 4 – inches nominal diameter through 6 inches nominal diameter, cleanouts shall be located at not more than 80ft. intervals

G. Each building drain shall be provided with a cleanout within 6ft. of the junction of the building drain and building sewer.

END OF SECTION 22 10 10

SECTION 22 40 00 - PLUMBING FIXTURES AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Plumbing Fixtures and Trim

1.2 RELATED WORK

A. Section 23 00 00 - General Mechanical

B. Section 22 10 00 - Plumbing Piping

C. Section 22 10 10 - Plumbing Specialties

1.3 SUBMITTALS

A. Furnish and install plumbing fixtures as shown on the accompanying drawing and in accordance with the approved rough-in drawings. This will include service sinks, lavatories, water closets, urinals, etc., with all brass in connection with supply tubing, traps, escutcheons, stop and basin cocks, etc. All fixtures shall be new and must be delivered to the building properly crated and in perfect condition.

B. All brass must be best quality. All brass pipe to be seamless brass tubing and all fixture traps shall be heavy with C.O. plugs. Nipples shall be extra heavy. Lightweight goods will not be accepted. All exposed metal on fixtures shall be C.P. or Chromard. All "P" traps shall be complete with cleanout plug.

C. Contractor shall submit in his fixture brochure for approval, a rough-in sheet of each fixture and indicate any variation required for the fixtures. Fixtures are to be roughed-in in accordance with these approved rough-in sheets and anchored so that piping cannot be moved.

1.4 JOB CONDITIONS

A. Check millwork shop drawings. Conform location and size of fixtures and openings before rough-in and installation.

PART 2 PRODUCTS – see plans

PART 3 EXECUTION

3.1 INSTALLATION

A. Install furnish and install all plumbing fixtures and accessories according to manufacturer's instruction and according to national, state and local codes governing the various systems. Carefully review the Architectural floor plans and millwork details to determine exact number of all fixtures, outlets, and accessories required. Coordinate all fixtures, outlets, drains, accessories, etc., prior to submitting shop drawings.

B. Install each fixture in accordance with rough-in drawings as per manufacturers recommendations. At completion thoroughly clean plumbing fixtures and equipment. Anchor fixtures rigidly; anchor piping in walls so that piping cannot be moved.

C. Provide chrome plated rigid or flexible supplies to fixtures with stops, reducers and escutcheons.

E. Install each fixture with trap, easily removable for servicing and cleaning.

F. All fixtures supplied with domestic water, hot or cold, shall be installed with integral stops on all supply lines.

G. Mount fixtures to the following heights above finished floor:
   1. Water Closets:
      a. Standard — 15" to top of bowl rim
      b. Handicapped — 18" to top of seat
   2. Urinal:
      a. Standard — 22" to top of bowl rim
   3. Lavatories:
      a. Handicapped — 34" to top of basin rim
   4. Water Closet Flush Valves:
      a. Standard — 11" min. above bowl rim'

H. Contractor shall caulk all joints at walls and floors with plumbing fixtures.

I. Contractor shall provide approved ADA drain and water line insulation covers on all exposed services for lavatories and sinks. Truebro Lav Guard or approved equal.

3.2 FIXTURE ROUGH-IN SCHEDULE:

A. Rough-in fixture piping and size connections shall be in accordance with the following table of minimum sizes for particular fixtures unless noted different on the drawing:

PLUMBING FIXTURE ROUGH-IN SCHEDULE

DESCRIPTION	C.W.	H.W.	WASTE	VENT
WATER CLOSET (FLUSH VALVE)	1"	--	4"	3"
URINAL (FLUSH VALVE)	3/4"	--	2"	1-1/2"
LAVATORY	½"	--	2"	1-1/2"
SERVICE SINK	½"	½"	3"	2"
ELECTRIC WATER COOLER	½"	--	2"	1-1/2"
SINK	½"	½"	2"	1-1/2"
HOSE BIBB	3/4"	--	--	--
2" FLOOR DRAIN	--	--	2"	1-1/2"
3" FLOOR DRAIN	--	--	3"	2"
3" HUB DRAIN	--	--	3"	2"

WATER PIPE SIZING TABLE

UNLESS SHOWN OTHERWISE, DOMESTIC WATER LINES SHALL RUN CONCEALED OVERHEAD AS DESIGNATED IN PLUMBING FIXTURE SCHEDULE AND BE SIZED ACCORDING TO TABLE BELOW.

PLANS AND RISER DIAGRAMS DO NOT NECESSARILY SHOW ALL PIPING RUNS. INSTALL A FACTORY SHOCK ABSORBER AT TOP OF EACH FIXTURE GROUP AND ALSO AT WATER HEATERS.

NUMBER OF FIXTURES*	PIPE SIZE (IPS)
2 OR LESS	1/2"
3 TO 5	3/4"
6 TO 10	1"
11 TO 15	1-1/4"
16 TO 28	1-1/2"

*FLUSH VALVE WATER CLOSET IS EQUIVALENT TO SIX (6) FIXTURES SIZES INDICATED ABOVE ARE

MINIMUM SIZES TO BE USED UNLESS OTHERWISE STATED

END OF SECTION 22 40 00

DIVISION

23

HEATING, VENTILATION, AND AIR CONDITIONING

SECTION 23 00 00 - GENERAL MECHANICAL

PART 1 GENERAL CONDITIONS

1.1 WORK INCLUDED

A. The general conditions of the general specifications are made a part of these specifications and apply the same as if attached hereto. The contractor should, before bidding, read and thoroughly understand all general conditions, priority and scheduling.

1.2 SCOPE OF WORK

A. This section calls for the furnishing of labor, materials, equipment, and all the services, and of performing all operations required for the complete mechanical systems as hereinafter specified and/or shown on the accompanying drawings.

1.3 GENERAL REQUIREMENTS

A. Contractor shall install his work to meet and to accommodate work of other trades. This contractor shall be responsible for timely placing of sleeves in forms before concrete is poured. Cooperate with the general contractor and place pipes and ducts in floors, walls, furred spaces, etc., so there will be no delay. Sheet metal or iron pipe sleeves shall be provided for pipes passing through floors, wall or partitions.

B. Contractor shall furnish and properly install materials, devices, equipment, insulation, controls, appurtenances, etc., mentioned in these specifications and/or shown on plans or required to make a complete and satisfactory installation in working order whether fully shown or not.

C. Contractor should visit the site and acquaint himself thoroughly with conditions governing installation of his work.

D. All other plans shall be checked in relation to these plans so that all conditions will be furnished and installed in this contract to provide complete and satisfactory systems.

1.4 LAWS, RULES, REGULATIONS, FEES, ETC.

A. The entire mechanical work shall comply with rules and regulations of the local and state authorities having jurisdiction including the State Fire Marshal and the State Board of Health. All modifications required by the said authorities at any time shall be made by the mechanical contractor without additional charge. In cases where alterations to or deviations from this specification and accompanying plans are required by the authorities, contractor shall report same to the Architect and obtain his approval before work is started.

1.5 DRAWINGS

A. Plans and detail sketches are submitted to limit, explain, and define structural conditions, specified requirements, pipe sizes, and manner of erecting work. Structural or other conditions may require certain deviations from manner of installation shown, and such deviations shall be made as required, but specified sizes and requirements necessary for satisfactory operation shall remain unchanged.

B. It may be necessary to shift or to change routing of ducts and or piping and this shall be done, but such changes must be referred to Architect for approval before proceeding. Extra charges will not be allowed for these changes.

C. Typical details are shown on plans, and in any cases where Contractor is not certain about

the method of installation of this work, he shall ask for details, lack of details will not be an excuse for improper installation.

D. Contractor bidding on this portion of the work must be fully experienced in installations of equal size, complexity and quality. In bidding, he acknowledges that he fully understands the scope of the work and design and has the ability, for the contract price to assemble and install the equipment, piping, and ductwork shown or specified, so as to mold same into a satisfactory workable system and arrangement, without responsibility for capacities and sizes set by these documents.

E. Contractor shall recognize that the amount of information and detail that could be provided in Contract Documents is limitless and could extend into every minute detail, step, sequence, and operation to a point where only workmen would be required, without drawing on ability experience, and ingenuity of the Contractor.

1.6 MATERIALS

A. Where directed by the Architect, Contractor shall submit sample for approval before proceeding.

1.7 STANDARDS

A. In general, standards for products and workmanship shall be as described in each individual section.

B. The standards referred to, except as modified in these specifications shall have full force and effect as though printed in these specifications. These standards are not furnished to bidders for the reason that the manufacturers and trades involved are assumed to be familiar with their requirements. The Architect will furnish, upon request, information as to how copies of the standards referred to may be obtained.

C. Notwithstanding any reference in this section of the specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalogue number, such references shall be interpreted as establishing a standard of quality and shall not be construed limiting competition and the Contractor in such cases, may at his option, use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect, expressed in writing, is equal to that specified.

1.8 MATERIALS SPECIFIED OR SUBSTITUTED (Prior Approvals)

A. Refer to Instructions to Bidders.

1.9 SHOP DRAWINGS

A. Before proceeding with the work, contractor shall make complete shop and working drawings of such apparatus or connections as directed by the Architect and/or hereinafter specified. These drawings shall show construction details and dimensions of each piece of equipment so drawn.

B. Architects approval of shop drawings shall not relieve the Contractor from responsibility of incorrectly figured dimensions or any other errors in these drawings or specified even though approved by the Architect, shall not relieve this Contractor from furnishing and erecting same.

C. Ten (10) sets of prints of shop drawings shall be submitted to Architect for approval. These prints shall be supplied as part of this contract. Submit all shop drawings at the same time or as soon as practical after award of the contract. No separate items will be accepted.

D. Where laws or local regulations provide that certain accessories such as gauges, thermometers, relief valves and parts be installed on equipment, it shall be understood that such accessories shall be furnished if no specific reference to them is made in the specifications.

1.10 CUTTING AND PATCHING

A. All cutting necessary for this work will be done by this Contractor at his own expense, but all patching shall be done by the General Contractor. No beams or joists shall be cut without prior approval of Architect. After initial resurfacing has been done any further cutting, patching or painting shall be done at the expense of this Contractor.

1.11 INTERFERENCES

A. The drawings are generally diagrammatic and this Contractor shall harmonize his work with that of the different trades so that interferences of the different equipment, piping, etc., shall be installed so as to function properly. In the case where interference develops, the Architect is to state which equipment, piping, etc., is to be relocated regardless of which item was first installed.

1.12 EXCAVATION AND BACKFILL

A. This Contractor shall do all excavating required to lay the specified services and after same have been laid, he shall do all backfilling to the satisfaction of all parties concerned and shall cart away from the premises all unnecessary dirt, rubbish, etc., as directed. Backfill shall be well tamped. All piping must be a minimum of 36” below grade. Piping must be set in 12” of sand.

1.13 SPACE REQUIREMENTS

A. Contractor shall check all plans pertaining to this job so as to be fully aware of the space limitations for all various items of equipment. Equipment is not to be bid on, submitted for preliminary approval nor placed on the job if it is so bulky and large that adequate access for proper maintenance and servicing cannot be achieved in the space provided.

1.14 FOUNDATIONS AND SUPPORTS

A. This contractor shall furnish and install foundations and supports of concrete or steel shapes for equipment requiring same, unless specifically indicated otherwise or specified.

B. All floor mounted mechanical equipment shall be mounted on 4" high concrete housekeeping pad unless specifically shown otherwise on plans. Refer to plans for special requirements for foundations and supports.

1.15 HANGERS, ESCUTCHEONS, ETC.

A. See Section 23 05 29 – Supports and Anchors.

B. Mechanical Contractor shall furnish and install all thimbles, inserts and other requirements necessary for the support of his equipment and piping. Assist and cooperate with other trades in locating and placing these items.

C. All sanitary and storm sewer piping shall be supported by stainless steel clevis hangers every 5’ and within 12” of each elbow. All hangers must be tied to the structural steel in the slab.

1.16 CEILING AND WALL ACCESS PANEL

A. Factory made access doors and frames, prime coat finish, screw driver latch(s) of suitable size as required.

B. Access panels in rated ceiling to have same rating as ceiling.

C. Where valves, dampers, controls, fire dampers, smoke dampers, and detectors, reheat coils, etc. are concealed in walls or non-accessible ceilings, install factory made access doors and frames.

1.17 DUCTWORK ACCESS PANELS

A. Access panels in ductwork to be double wall type with insulation sandwiched in between, same insulation value as adjacent ductwork.

1.18 SIPHON PREVENTERS

A. Furnish and install approved type siphon preventors on all equipment and fixtures in such a manner as to prevent water being siphoned back into the water supply in the event the water supply is shut off.

1.19 FLAME SPREAD PROPERTIES OF MATERIALS

A. All materials and adhesives used for acoustical linings, jackets and insulation shall comply with requirements of NFPA 90A and 90B and UL guide # 40V.8.15. Products exceeding a flame spread rating of 25, or a smoke developed rating of 50, as determined by ASTM Test Method E-84 are prohibited. Adhesives and sealers shall be fire retardant and fire resistant when dry. Flame proofing treatments which are subject to decomposition, deterioration, or the effects of moisture are prohibited.

1.20 DOMESTIC AND FIRE WATER TIE-IN

A. Contractor shall provide any necessary meters and tap fees for domestic or fire water tie-ins to utility companies. All domestic and fire water taps shall have aboveground reduced pressure back flow preventors near the tie-in point. Coordinate with Engineer exact location.

B. All backflow preventors shall be installed in an insulated Hot Box with aluminum cover. The enclosure shall have a minimum of 500w freeze protection. Provide all necessary electrical requirements.

1.21 PROTECTION OF EQUIPMENT

A. See individual sections for protection of equipment.

B. This Contractor shall at all times take such precautions as may be necessary to properly protect his equipment from damage. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Architect will be sufficient cause for the rejection of the particular piece of equipment in question.

1.22 TESTING

A. All pressure lines, unless elsewhere specified, shall be tested under 150# hydrostatic pressure unless rated pressure is less for a minimum of 5 hours. Contractor shall provide valve at farthest point in line to bleed off air and for inspection.

B. Notice shall be given the Architect before tests are made, the test is not to be drawn off pipes and pipes are not to be covered or insulated until filled pipes have been examined and testing approved by the Architect.

C. In case of defects, they shall be made good to the satisfaction of the Architect and work retested. All such work shall be done by the Contractor with no additional expense to the Owner.

D. Contractor shall make any other such tests as may be called for by the Architect, and all other tests so called for elsewhere in these specifications.

1.23 CLEANING AND ADJUSTING

A. Before receiving final approval from the Architect, the Contractor shall clean out all lines; adjust all valves, control equipment and other equipment. Clean all pipe and equipment and leave the entire installation in good working order. All heaters, fans, grilles, controls, etc., shall be adjusted to perform in correct and satisfactory manner, with sequences, etc., as called for in the specifications hereinafter specified and on plans.

1.24 PAINTING

A. Refer to Section 09 91 23 – Interior Painting and 23 05 53 – Mechanical Identification for painting requirements.

1.25 MOTORS, MOTOR STARTERS AND ELECTRICAL WORK

A. Refer to Section 23 05 13 - Motors.

B. Motors shall be suitable for voltage indicated on the plans, plus or minus 10% and be designed for constant operation at 40 degrees C ambient, 65 degrees C rise for class A, 90 degrees C rise for Class B, etc. Electrical equipment furnished under this contract shall meet standards as set forth by NEMA and NEC requirements. All electrical equipment shall be UL labeled.

1.26 PARTS LIST AND INSTRUCTION MANUAL

A. See individual sections for specific instructions.

B. This Contractor shall deliver to the Architect three (3) copies of printed instructions relating to operating, proper maintenance and repair parts list indicating the various parts by name, number and diagram for each piece of equipment installed. Test and balance report shall also be included in parts list and instruction manual.

C. The shop drawings, parts list, and maintenance and repair instructions shall be neatly bound in a canvas-covered notebook and turned over to the Architect before acceptance of the work.

1.27 BOILER TEST CERTIFICATES

A. Each boiler, water heater (with a capacity equal to or greater than 50 gallons), and pressure vessels are to be inspected by a State of Louisiana certified inspector upon installation.

B. Submit a copy of each report to the Architect and include one copy in each of the Close-out Manuals.

1.28 GUARANTEE/ Warranty

A. Contractor shall guarantee materials, equipment and workmanship installed and performed under this contract for a period of one (1) year from date of the final completion and official acceptance of the contract.

B. He shall furnish free of charge to the Owner all materials and labor necessary to comply with

the above guarantee, which shall be based on defective materials and/or workmanship, and on such basis shall be responsible if a deficiency is found, for any adjustment, replacement, or correction which may be necessary to replace the project to first class condition. This guarantee shall include refrigerant charges, but shall not include the changing of filters.

1.29 RECORD DRAWINGS

A. The Contractor shall maintain a set of record drawings on-site throughout the construction. The record drawings shall reflect accurate dimensional record of all underground, buried, above ceiling, or otherwise concealed work.

B. The Contractor shall maintain these record documents and keep them up-to-date daily.

END OF SECTION 23 00 00

SECTION 23 00 01 - MECHANICAL GENERAL PROVISIONS – COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Division 23 will be responsible to carry out the commissioning requirements specified in Section 23 08 10, 01 91 13 and other sections referenced in 01 91 13.

END OF SECTION

SECTION 23 01 00 - MECHANICAL COORDINATION DRAWINGS

PART 1 GENERAL CONDITIONS

1.1 SECTION INCLUDES

A. Coordination Drawings

B. Coordination with Requirements of related sections of the specifications.

1.2 RELATED SECTIONS

A. Refer to Mechanical, Plumbing, and Sprinkler sections.

1.3 COORDINATION DRAWINGS

A. The Contractor shall coordinate work of all various sections having interdependent responsibilities for installing, connecting to, and placing such equipment. All (including, but not limited to, mechanical, plumbing, sprinkler system) necessary offsets, beds, duct size/configurations, crossings/crossovers shall be provided and installed as necessary to integrate within the structural system and the architectural features (ceilings and walls, etc.)

B. Coordination Drawings: The purpose of the coordination drawings is to assure proper forethought and coordination of the subcontractors and their installation and integrating of all systems of the building within the structural framework, architectural ceilings, floors, and walls of the building. The Contractor shall provide coordination drawings prior to the submittal of all system shop drawings. The coordination drawings shall include ductwork and all mechanical HVAC piping and associated items, plumbing verticals and sprinkler piping, chases, and shall indicate sizes of these items and the structural members.

C. The Contractor shall submit the Coordination Drawings to the Architect for the Architect's review no later than one month after the Work has commenced on the project site. The Architect's review is only for assistance to the Contractor and to assure general design intent.

D. The Coordination Drawings shall include, but is not limited to, the following:
   1. Plan drawings for each floor indicating structural member sizes, HVAC components sizes/routes/locations, major electrical conduit grouping/routes, vertical chases/openings, and all other items as necessary to comply with the requirements of 1.03.A and 1.03.B of this section.
   2. Section Drawings through major pathways for systems (such as corridors, if appropriate), and exemplary rooms.
   3. Any and all other drawings, schedules, and information necessary to illustrate the Contractor's understanding of the architectural design intent of the critical ceiling heights, wall locations, and all other design parameters and how they are accommodated upon the Contractor's proposed integration of the Systems noted in the Contract Documents.

E. During construction, the Contractor shall update the Coordination Drawings in a clean, clear, and legible manner for continuous reference by the Design Team. Upon Substantial Completion, the Contractor shall submit the updated Coordination Drawings and Specifications to the Architect to assist the Architect in the preparation of the Record Documents.

F. If the Contractor proceeds prior to the submittal and review of the Coordination Drawings, he does so at his own risk; the Owner will not compensate the Contractor for any revisions necessary for work already in place (that the Architect interprets) to be as a result of conflict of systems layout, planning, and/or coordination.

END OF SECTION 23 01 00

SECTION 23 05 00 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Carbon steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
1. Finish: Polished chrome-plated and rough brass.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve and equipment servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section 07 84 13 "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

S. All piping shall be installed so it is protected during freezing conditions.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 and 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated. All work in accordance with NFPA 101

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section 05 50 00 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 05 00

SECTION 23 05 13 - MOTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single phase electric motors.

B. Three phase electric motors.

1.2 RELATED WORK

A. Section 23 21 23 – Pumps

B. Section 23 36 00– Air terminal Units

C. Section 23 34 10 – Exhaust Fans

D. Section 23 65 00 – Cooling Towers

E. Section 23 70 00 - Central Station Air Handler

1.3 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

D. ANSI/NEMA MG 1 - Motors and Generators

E. ANSI/NEMA 70 - National Electrical Code

1.4 SUBMITTALS

A. Submit product data under provisions of Sections 01 33 00 – Submittal Procedures & 23 00 00 – General Mechanical.

B. Submit test results verifying nominal efficiency and power factor for three phase motors larger than 5 horsepower.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 23 Operation and Maintenance Datat.

B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of electric motors for commercial use, and their accessories, with documented product development, testing, and manufacturing experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 33 00 – Submittal Procedures.

B. Store and protect products under provisions of Section 01 33 00 – Submittal Procedures.

C. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. (For extended outdoor storage, remove motors from equipment and store separately).

1.9 WARRANTY - See General Section 23 00 00– General Mechanical.

PART 2 PRODUCTS

2.1 MOTORS

A. Motors controlled by VFD's shall comply with NEMA MG1, Part 31, Definite Purpose Inverter Fed Motors (withstand repeated voltage peaks of 1600V with rise times of 0.1 microseconds and greater).

B. Starters for single phase motors which are not automatically started shall be manual type with melting alloy thermal overload protection and pilot light. Starters for automatically controlled single phase motors shall be magnetic type with NEMA rated AC magnetic contactor, melting alloy thermal overloads and pilot light.

C. Starters for three phase motors 25 horsepower and below shall be combination type starter/disconnect, full voltage non reversing (FVNR), with magnetic NEMA rated contactors rated for horsepower of motor served, adjustable trip magnetic circuit breaker disconnect (circuit breaker, not a fused switch) capable of being padlocked in the open position, 10K a/c minimum fault rating with higher rating when necessary due to available faut levels. Starters shall have a fused 100VA minimum control transformer (120V unless required otherwise), HOA switch, push to test operating pilot light, solid state overload relays set for actual motor nameplate full load amps, phase failure and phase reversal protection relay, minimum two NO. and two N.C auxiliary contracts and terminal blocks factory prewired for field wiring. Starters shall be housed in a NEMA 1 enclosure for indoor locations and NEMA 3R enclosure for outdoor or wet locations. Only to be used if VFD are not called for on plans.

D. Starter for motors 30 horsepower and above shall be soft start type or variable frequency drives

E. Coordinate with electrical and specify fault rating on all motor controllers.

F. Winding heaters shall be installed on all chilled water pumps. These shall be energized when pumps are deenergized.

2.2 MANUFACTURERS

A. Electrical Service - Refer to Division 26 for required electrical characteristics.

B. Motors: Design for continuous operation in 40 degrees C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.

C. Visible Nameplate: Indicating motor information as required by NEC 430-7(a).

D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional

horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

E. Starters: General electric, Cerus Industrial

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A 65 degree C temperature rise insulation, Minimum 1.15 service factor, pre-lubricated sleeve or ball bearings, automatic reset overload protector.

2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A 65 degree C temperature rise insulation, NEMA service factor, prelubricated sleeve ball bearings.

G. Enclosed Motors: Class A 65 degree C temperature rise insulation, NEMA service factor, prelubricated sleeve ball bearings.

2.5 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between one and one-half times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to ANSI/NEMA MG for design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with ANSI/IEEE 12, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data.

G. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Thermister System (Motor Frame Sizes 254T and larger): Three PTC thermister imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor

starter.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: To ANSI/NEMA MG1.

K. Nominal Efficiency: Meet or exceed values in schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112, and ASHRAE 90.1.

L. Motors, Motor Starters and Electrical Work: Mechanical Contractor shall furnish all motors, motor starters, start-stop push buttons, pilot lights, firestats, interlocking diagrams, etc. for each piece of motor driven equipment under this Contract. Mechanical Contractor shall install all motors. All motor starters, start-stop push buttons, pilot lights, etc. shall be turned over to the Electrical Contractor for installation. Electrical contractor shall be responsible for power wiring. This contractor will be responsible for control wiring.

M. Motor Starters and Push Buttons: All automatic starters shall be nominal 600 volt rating. All starters shall have two (2) auxiliary contacts.
1. Starters for single speed motors, 3/4 through 25 HP inclusive, shall be magnetically operated, "Across-the-line" 3 phase, with three overload relays, "HAND-OFF-AUTO" selector switch and pilot in cover. Starters shall be combination type with fused or circuit breaker type disconnect mechanism.
2. Starters for 30 HP and larger are to be reduced voltage, auto-transformer, combination type with fused or circuit breaker type disconnect mechanism. Starters shall be complete with three overload relays, "HAND-OFF-AUTO" selector switch and pilot lights.
3. Enclosures for starters mounted indoors shall be NEMA 1. Enclosures for starters mounted outdoors or in wet areas shall be NEMA 3 R.
4. Remote push button stations shall be as follows: Start-stop stations shall be recess mounted with neon pilot lamp of proper voltage.
5. Push buttons for controls which are interlocked with automatic controls shall be maintained contact type. All others may be of momentary contact type.
6. Control voltage for all motor starters shall 120 volts provided by integral control voltage transformers.
7. If the Mechanical Contractor purchases equipment of larger horsepower than specified or shown on the plans, he shall pay all costs to increase the wiring and conduit.

PART 3 EXECUTION

3.1 APPLICATION

A. Motors drawing less than 250 watts and intended for intermittent service may be germaine to equipment manufacturer and need not conform to these specifications.

B. Motors shall be open drip-proof type, except where specifically noted otherwise.

C. Single phase motors for shaft mounted fans or blowers shall be permanent split capacitor type.

3.2 NEMA OPEN MOTOR SERVICE FACTORS

HORSEPOWER	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15

3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15

3.3 MOTOR EFFICIENCY

A. Each motor furnished on the job must meet ASHRAE 90.1 and shall have a minimum guaranteed efficiency as listed in table below. Minimum guaranteed efficiencies for all motors shall be clearly stamped on motor nameplate. The lack of such stamp shall be cause for rejection of motor.

HORSEPOWER	EFFICIENCY
1, 1-1/2, 2	84.00
3	88.50
5, 7-1/2, 10	90.20
15, 20	91.70
25, 30, 40	93.00
50, 60, 75	94.10
100, 125, 150, 200	95.00

END OF SECTION 23 05 13

SECTION 23 05 15 - VARIABLE FREQUENCY DRIVES (VFD)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Variable Frequency Drive (VFD)
   2. Options, including bypass (3 Contactor)

1.2 REFERENCES

A. UL 508

B. UL 94

C. CSA 22.2 no.14

D. NEMA ICS 3, ICS 4

E. IEEE 444 (ANSI-C343)

F. IEEE 519-1981

G. IEC 146A

1.3 SUBMITTALS

A. Product Data
   1. General description
   2. Ratings and weights

B. Shop Drawings
   1. Outline dimensions
   2. Mounting points
   3. Interconnecting wiring diagrams

C. Manufacturer's Installation Instructions
   1. Installation methods
   2. Connection points

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB

B. GE

C. Yaskawa

D. Danfoss

2.2 VARIABLE FREQUENCY DRIVE (VFD)

A. DESCRIPTION: VFD converts fixed frequency utility power into adjustable frequency power necessary to operate three phase AC motors at variable speed. VFD incorporates microprocessor logic to ease user set up for application functions. VFD shall be Bacnet

compatible.

B. OPERATING PRINCIPLE: Input three phase AC line voltage is first rectified to a fixed DC voltage. Using pulse width modulation (PWM) inverter technology, the DC voltage is processed to produce an output voltage waveform in a series of variable width pulses. Because of high frequency of these voltage pulses, output current closely approximates a true sinusoidal waveform.

C. SERVICE CONDITIONS:
1. Operating ambient temperature - 10 to 40 C
2. Storage temperature - 20 to 60 C
3. Relative humidity to 90 % noncondensing
4. Vibration 1 G max under 20 Hz; 0.2 G at 20 to 60 Hz.

D. STANDARD ENCLOSURE:
1. Power electronics and control electronics housed in NEMA 1 wall mount enclosure.

E. ELECTRO-MECHANICAL CONSTRUCTION:
1. Input voltage 460 volt model for nominal (+/-10%), 460 VAC systems.
2. Output current overload rating of 125% of motor FLA for 1 minute.
3. Voltage source design using PWM inverter technology.
4. Microprocessor based control circuit generating sine coded PWM output current waveform.
5. Non-volatile memory (NV RAM); all programming is maintained when disconnected from power.
6. Corrects displacement power factor to 98 % throughout the motor speed range and eliminates power line notching, through the use of diode bridge input section or power factor correction capacitors and isolation transformer.
7. Input phase insensitive, sequencing of the 3 phase input lines is not required.
8. Capable of single phase input operation - requires 50% drive derating and a three phase motor on the output.
9. Fused DC bus with capacitive filtering.
10. Insulated Gate Bipolar Transistors (IGBT) output, allowing motor noise, at 60 Hz, less than 2 dB (@ 1 meter) above that resulting from across the line operation. The VFD manufacturer must provide output reactor to reduce noise.
11. Three current transformers detect the output current to provide: Electronic thermal overload protection, Three phase current limit, Ground fault protection, Short circuit protection and Speed search capability.
12. Surface mount technology with conformal coating provides 100,000 Hrs MTBF at the specified service conditions.
13. Digital operator keypad and display provides local control and readout functions -or- provide individual meters for readout and PLC for terminal status indication:
    a. Run / Stop / Jog commands.
    b. Speed command.
    c. Reset command.
    d. Output frequency meter and speed command meter, which can be programmed for other speed related indications including, RPM, CFM, FPM and, % max. RPM.
    e. Volt meter, Amp meter, Kilowatt meter functions.
    f. Input and output terminal status indication.
    g. Diagnostic indication.
14. Power electronics provides efficiency of 97% minimum.
15. Materials of construction UL 94-V0 rated.
16. Physical size and weight.
    a. Less than 180 cubic inches/horsepower for 5 to 75 HP drives.
    b. Less than 5 pounds/horsepower for 5 to 75 HP drives.

F. PERFORMANCE FEATURES:
1. Output frequency and voltage modulation with selectable volts/hertz ratio for optimum variable torque output.
   a. Output frequency from 0 to 400 Hz.
   b. Output voltage from 0 to motor rated voltage.
2. Fixed carrier frequency programmable up to 15 KHz, allowing motor noise, at 60 Hz, less than 2 dB (@ 1 meter) above that resulting from across the line operation -or- output reactor must be provided to reduce noise.
3. Compatible with standard NEMA B motors. All motors that are run by VFD shall be inverter duty rated.
4. UL listed.
5. Lock out reverse operation.
6. Drive defaults to 80% of last speed through internal logic.
7. Soft start, linear or S-curve function.
8. Ramp to stop or coast to stop selection.
9. Provide braking through DC injection with voltage level, current limit and duration adjustable, and selectable for either stop, deceleration braking or braking before start, anti-windmill braking.
10. Critical frequency rejection capability in 3 ranges with adjustable span of 0 to 10 Hz to avoid possible vibration problems at driven equipment resonant frequencies.
11. 2 second momentary power loss ride thru (drive logic is maintained).
12. Auto restart, up to 10 attempts.
    a. Start into free running (coasting) motor via speed search feature.
13. High starting torque capability for high inertia loads.
14. Full range auto torque boost for high inertia loads.
15. Stall prevention.
16. Standard frequency reference (speed) input signals; 0-10 Vdc, 4-20 mA.
17. Accepts reverse or direct acting frequency reference input signal.
18. Programmable bias and gain for frequency reference input signal.
19. External fault input (i.e. firestat or freezestat) programmable to command ramp to stop, coast to stop, emergency stop or continue operation.
20. Speed search to start a rotating motor and load.
21. Terminals and programming for remote run/stop and speed reference.
22. Remote operation run/stop, 2 wire or 3 wire control.
23. Local/remote operation input via contact closure.
24. Analog output (0 to 10 Vdc) proportional to frequency or current.
25. Run/fault output contacts (1 amp resistive) selectively activated at initial fault occurrence or after final auto restart attempt.
26. Stall prevention by reducing output voltage and frequency during momentary overload. Automatically resume normal operation when overload clears.
27. Digital diagnostic indication and protection for:
    a. DC bus undervoltage and overvoltage.
    b. Load over torque.
    c. Fuse blown.
    d. Motor overload.
    e. Heatsink over temperature.
    f. Instantaneous over current.
    g. Operator error.
    h. Central processor fault.
    i. External fault.
    j. Dynamic braking fault.

G. ADJUSTMENTS AND PROGRAMMABILITY:
1. Incremental / Floating Point control.
   a. One contact closure input causes acceleration for duration of the closure, another causes deceleration. When both switches are open the last speed

command is held.

2. Factory default settings for most common HVAC applications. These settings can be easily re-established thru a reset code.
3. Program security code.
4. 30 operational changes possible in control and display functions without stopping the drive including:
   a. Acceleration and deceleration time.
   b. Frequency command.
   c. Frequency command bias and gain.
   d. Multi-step speed references.
   e. Jog reference.
   f. Monitor display.
5. Two independent, selectable acceleration/deceleration ramp times.
6. Acceleration time from .1 to 6000 seconds.
7. Deceleration time from .1 to 6000 seconds.
8. Maximum and minimum output frequency from 0 to 400 Hz.
9. Programmable upper and lower frequency limits.
10. 15 pre-set selectable Volts/Hertz (V/Hz) patterns plus 1 custom pattern.
11. Auto speed reference (instrument follower) input signal adjustable for bias and gain.
12. Programmable start and stop ramp time.
13. Four programmable multi-function input terminals.
14. Multi-function output contacts programmable for:
    a. Run mode Zero speed detect
    b. Over torque detect Coast to stop detect
    c. Run reference mode Speed reference mode
    d. Output frequency detect Speed synchronization
    e. Low voltage detect Operation ready
    f. Speed reference missing Braking resistor fault
    g. Drive fault Fire stat /freeze stat.
15. Adjustable torque and current limit from 0 to 170%.
16. Ramp to stop or coast to stop selection.
17. Adjustable upper and lower frequency limits independent of pre-set V/Hz pattern.
18. Programmable lock out code, to prevent operator access to parameter settings.
19. 9 selectable pre-set speed programming capability.
20. Programmable jog speed.

2.3 COMPONENTS

A. Input section - VFD power input stage converts three phase AC line power into a fixed DC voltage via a solid state full wave diode rectifier with metal oxide varistor (MOV) protection.

B. Intermediate section - DC bus maintains a fixed DC voltage with filtering and short circuit protection as a DC supply to the VFD output section. It is interfaced with the VFD diagnostic logic circuit to continuously monitor and protect power components.

C. Output section - Insulated gate bipolar transistors (IGBT) convert DC bus voltage to variable frequency and voltage PWM sine coded output to the motor.

2.4 ACCESSORIES / OPTIONS

A. Bypass control allows operation of the motor across the line should the VFD require service:
   1. Bypass and drive are factory assembled and electrically interlocked.
   2. VFD can be removed with bypass control left in place. (3 Contactor)
   3. NEMA 1 enclosure.
   4. Door interlocked disconnect.
   5. VFD input contactor.
   6. VFD output contactor.

7. Bypass contactor.
8. Overload relay.
9. 115 VAC control transformer.
10. Safety circuit terminal strip.
11. Drive-Off-Line selector.
12. Power on light.
13. VFD select light.
14. Line select light.

B. Manufacturers startup service.

C. Input circuit breaker disconnect.

D. Input fusing.

E. Input interface for digital (parallel) speed reference input signal.

F. NEMA 1 enclosure.

G. Operator controls, custom, remote.

H. Serial interface.

I. Set point controller (PID).

J. Transformer, isolation.

2.5 SOURCE QUALITY CONTROL

A. Mean time between failure (MTBF) 100,000 hours minimum.

B. In-circuit testing of all printed circuit boards.

C. Printed circuit boards burned in for 96 hours at 85 C.

D. Functional testing of printed circuit boards after burn in.

E. Fully assembled VFD tested with induction motors.

F. All integrated circuits tested to .5% AQL acceptance criteria.

PART 3 EXECUTION

3.1 INSTALLATION AND STARTUP OF EQUIPMENT

A. Per manufacturer's installation and technical manual.

B. Manufacturer's application engineering department to be accessible for consultation during startup.

C. Commissioning agent shall be present for the start up for all major equipment.

END OF SECTION 23 05 15

SECTION 23 05 16-EXPANSION COMPENSATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. Flexible pipe connections.

1.2 RELATED WORK

A. Section 23 21 13 - Hydronic Piping

B. Section 23 05 23 - Supports and Anchors

C. Section 22 10 00 – Plumbing Piping

1.3 DESIGN CRITERIA

A. Base expansion calculations on 50 degrees F installation temperature to 210 degrees F for hot water heating and 140 degrees F for domestic hot water, plus 30 percent safety factor.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 01 30 00 – Administrative Requirements.

B. Flexible pipe connector shop drawing data to include maximum allowable temperature and pressure rating, overall face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure and total number of wires in braid.

C. Expansion joint shop drawings to include maximum allowable temperature and pressure rating, and maximum expansion compensation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S

A. Flexicraft Model N.

B. Metraflex Model HP

2.2 FLEXIBLE PIPE CONNECTIONS

A. For steel piping construct with stainless steel inner hose and braided exterior sleeve.

B. For copper piping construct with bronze inner hose and braided exterior sleeve.

C. Use connectors suitable for minimum 125 psi WSP and 450 degrees F and 200 psi WOG and 250 degrees F.

D. Construct spool pieces to exact size for insertion of flexible connection.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation.

B. Accomplish structural work and provide equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints, and provide corrugated bellows type expansion joints where required.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

D. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so that movement takes place along axis of pipe only.

END OF SECTION 23 05 16

SECTION 23 05 23 - VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Butterfly Valves

B. Check Valves

C. Plug Valves

D. Drain Valves

E. Pet Cocksp

F. Ball Valves

1.2 RELATED WORK

A. Section 23 21 13 - Hydronic Piping

B. Section 23 21 23 - Pumps

C. Section 23 21 16 - Hydronic Specialties

1.3 SUBMITTALS

A. Submit copies of valve ordering schedule for approval prior to ordering valves.

B. Submit detailed shop drawings under provisions of individual sections. Clearly indicate make, model, type, size, and pressure ratings, and materials of construction.

1.4 APPROVAL OF PRODUCT PRIOR TO BIDDING

A. Refer to Instruction to Bidders.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Certain items in this Specification are listed by manufacturer and/or manufacturer’s model number to establish general style, type, character, and quality or product desired. Similar items manufactured by other than those listed will be considered, providing submittals are made according to Pre-Bid approval requirements of Instruction to Bidders.

B. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used and Pre-Bid Approval is not required.

C. Provide valves of same manufacturer throughout wherever possible.

D. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

2.2 VALVE CONNECTIONS

A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe

size valves.

B. Thread pipe sizes 2 inches and smaller.

C. Flange pipe sizes 2-1/2 inches and larger.

D. Solder or screw to solder adapters for copper tubing.

E. Provide butterfly valve with tapped lug body when used for isolating service.

2.3 BALL VALVES (All isolation valves are to be ball valves)

A. Ball valves 2" and smaller (heating coils) valves to be bronze body with stainless steel cartridge, threaded, combination valve and flow control. Control range 2-32 psid.

B. Manufacturer's: NIBCO T-590-Y-66 or Red & White 5092 or approved equal.

C. Ball valves 3" and larger (chilled water) to be cast steel 150 lbs. psig flange type, ASTM A216, GR. WCB carbon steel, 416 stainless steel stem and ball, Teflon gasket, malleable iron handles.

D. Manufacturer's: NIBCO F515 or Red & White 4151 or approved equal.

2.4 CHECK VALVES

A. Chilled Water, Hot Water:
Body: Cast iron ASTM A-48 Class 35
Seat: Bronze ASTM 145 Alloy
Disc: Bronze ASTM 145 Alloy
Spring: Stainless Steel Type 302
Bushing: 6" and smaller ASTM B-16 8" and larger ASTM 145
Set screws: Stainless Steel Type 304
Manufacturer's: NIBCO F-918-B, Red & White 435, B&G, or Armstrong

2.5 BALANCING VALVES (Eccentric Plug Type)

A. Valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as shown on the plans. Flanged valves shall befaced and drilled to the ANSI 125/150 lb. standard.

B. Port areas for valves through 20" shall be minimum 80% of ull pipe area and port areas of 24" and larger valves shall be minimum 70% of full pipe area.

C. Valve bodies shall be of ASTM A126 Class B cast iron in compliance with AWWA C504 Section 2.2. Bodies in 3" and larger valves shall be furnished with a welded overlay seat of not less than 90% pure nickel in accordance with AWWA C507 Section 7.2. Valves utilizing resilient seat attached to the body shall not be acceptable. As per AWWA C504-80 Section 35.2 and AWWA C507-73 Section 7.2, sprayed or plated seats are not acceptable, nor shall screwed in seats be acceptable.

D. Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable, re-packable without removing the bonnet or actuator from the valve, and re-packable under pressure. Shaft seals shall conform to AWWA C504-80, Section 3.7 and AWWA C507-73, Section 10.2. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable. All exposed nuts, bolts, springs, washers zinc plated.

E. Valve pressure ratings shall be 175 psi through 12" and 150 psi for 14" through 48". Each valve shall be given a hydrostatic and seat test.

F. Where required, valves shall be capable of providing drip-tight shutoff up to the full rating with pressure in either direction.

G. Acceptable Manufacturers
1. Dezurik Series 100
2. Alloyco 257A
3. Nexus

2.6 DRAIN VALVES

A. Bronze gate, class 125, ASTM B-62 with bronze wedge, hose cap and safety chain.

B. Acceptable Manufacturer's
1. NIBCO T-113-HC
2. Crane 1701

2.7 PRESSURE RATINGS

A. Unless otherwise indicated, use valves suitable for 150 minimum psig WSP and 450 degrees F and maximum 200 psig and 250 degrees F.

2.8 VALVE OPERATORS

A. Provide one plug cock wrench for every ten plug cocks sized 2 inches and smaller, minimum of one. Provide each plug cock sized 2-1/2 inches and larger with a wrench, with set screw.

B. For butterfly valves (provide gear operators for sizes 8 inches and larger. For smaller sizes, provide lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock nut and memory stop for throttling service.

C. Provide valves located more than 8 feet from floor in equipment room areas with chain operated sheaves. Extend chains to 4 feet above floor and hook to clips arranged to clear walking aisles.

D. All valves shall be furnished with valve stem extensions to facilitate insulation installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install S.S Ball valves for shut-off and isolating service, to isolate equipment, part of systems, or vertical risers.

C. Provide spring-loaded check valves on discharge of condenser water chilled water, and hot water pumps.

END OF SECTION 23 05 23

SECTION 23 05 29 - SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Pipe and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED WORK

A. Section 23 07 00 - Piping and Equipment Insulation.

B. Section 23 21 13 - Hydronic Piping.

C. Section 23 31 00 – Ductwork

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Indicate hanger and support framing and attachment methods.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S

A. Fee and Mason

B. Grinnel

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers for pipe sizes 1/2 to 1-1/2 inch: Galvanized Malleable iron, adjustable swivel, split ring.

B. Hangers for pipe sizes 2 to 4 inches and cold pipe sizes 6 inches and over: Carbon steel, adjustable, clevis.

C. Multiple or trapeze hangers: Galvanized Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes 6 inches and over.

D. Vertical Support: Galvanized Steel riser clamp.

E. Floor support for pipe sizes 4 inches and over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roller for hot pipe 6 inches and over.

F. Shields for insulated piping 2 inches and smaller: 18 gauge galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.

G. All hangers to be sized to include insulation.

2.3 HANGER RODS

A. Stainless Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.4 INSERTS

A. Inserts: Malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms, size inserts to suit threaded hanger rods.

2.5 FLASHING

A. Metal Flashing: 26 gauge galvanized steel.

B. Caps: Steel, 22 gauge minimum, 16 gauge at fire resistant elements.

2.6 SLEEVES

A. Sleeves for pipes through non-fire rated floors: Form with 18 gauge galvanized steel.

B. Sleeves for pipes through non-fire rated beams, walls, footings, and potentially wet floors: Form with steel pipe or 18 gauge galvanized steel.

2.7 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

2.8 FINISH – hot dipped galvanized

A. Prime coat exposed steel hangers and supports.

B. Protect against galvanic action with dielectric unions for dissimilar metals.

PART 3 EXECUTION

3.1 INSERTS

A. Provide inserts to General Contractor for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX HANGER SPACING	MIN. HANGER DIAMETER
1-1/2 TO 2 INCH	10' - 0"	3/8"
2-1/2 TO 3 INCH	10' - 0"	1/2"
4 to 6 inch	10' - 0"	5/8"
8 to 12 inch	10' - 0"	7/8"
14 to 20 inch	15' - 0"	1"

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

F. Support riser piping independently of connected horizontal piping.

3.3 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of reinforced concrete as detailed on plans.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Provide rigid anchors for pipes after vibration isolation components are installed.

3.4 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION ISOLATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. Inertia Bases

B. Vibration Isolation

1.2 RELATED WORK

A. Fire Protection System

B. Plumbing System

C. HVAC System

1.3 REFERENCES

A. ASHRAE - Guide to Average Noise Criteria Curves.

1.4 QUALITY ASSURANCE

A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Indicate vibration isolator locations, with static and dynamic load on each, on shop drawings and described on product data.

C. Submit manufacturer's installation instructions.

1.6 CERTIFICATES

A. Submit manufacturer's certificate that isolators are properly installed and properly adjusted to meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 INERTIA BASES

A. Pumps: Reinforced 3,000 psi concrete base with chamfered edges, without channel frame.

2.2 VIBRATION ISOLATORS

A. A.H. Units: Open spring mount with stiff springs. Horizontal stiffness equal to vertical stiffness. Minimum 1" deflection. No. and size of springs as per A.H. unit manufacturer's recommendations.

B. Color code spring mounts.

C. Select springs to operate at 2/3 maximum compression strain, with 1/4 inch (6 mm) ribbed neoprene pads.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install vibration isolators for motor driven equipment.

B. Set steel bases for one inch clearance between housekeeping pad and base. Set concrete inertia bases for 2 inch (50 mm) clearance. Adjust equipment level.

C. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inch diameter, first three points of support; 5 to 8 inch diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.

END OF SECTION 23 05 48

SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. Identification of all mechanical products installed under this Division.

1.2 RELATED WORK

A. Section 09 91 23 – Interior Painting

1.3 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Mechanical and plumbing contractors shall coordinate color codes and marking procedures.

1.5 APPROVAL OF PRODUCT PRIOR TO BIDDING

A. Refer to Instructions to Bidders, Page IB-3, Paragraph 4.3 Substitution.

PART 2 PRODUCTS

2.1 MATERIALS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.

C. Metal Tags: Brass with stamped letters, tag size minimum 1-1/2 inch (38 mm) diameter with smooth edges.

D. Stencils: With clean cut symbols and letters of following size:

OUTSIDE DIAMETER OF INSULATION OF PIPE	LENGTH OF COLOR FIELD	SIZE OF LETTERS
3/4" - 1-1/4"	8"	1/2"
1-1/2" - 2"	8"	3/4"
2-1/2" - 6"	12"	1-1/4"
8" - 10"	24"	2 - 1/2"
Over 10"	32"	3 - 1/2"
Ductwork & Equipment	-------	2 - 1/2"

E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing printed markings.

F. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6" wide by 4 mil thick manufactured for direct burial service.

PART 3 EXECUTION

3.1 PREPARATION AND INSTALLATION:

A. Degrease and clean surfaces to receive adhesive for identification material.

3.2 INSTALLATION

A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners, or adhesive.

B. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

C. Plastic type Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.

D. Underground Plastic Pipe Markers: Install 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

E. Equipment: Identify air handling units, pumps, heat transfer equipment, tanks and water treatment devices, and motor starters with plastic nameplates. Small devices, such as in-line pumps, may identified with plastic tags.

F. Controls: Identify control panels and major control components outside panels with plastic nameplates.

G. Valves: Identify valves in main and branch piping with tags.

H. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side penetration of structure or enclosure, and at each obstruction.

3.3 PAINTING

A. All surfaces requiring painting shall be left clean by the Mechanical Subcontractor. All painting shall be done by the General Contractor's painting Subcontractor. All exposed piping or insulation, convectors, grilles, or fans, in building or on roof will be painted. Paint pipe, equipment, hangers and accessories in Equipment Rooms including covering and foundations with two (2) coats of approved paint after thoroughly cleaning. Equipment having factory finish shall be touched up and given one (1) additional coat of machinery enamel color as selected. The above shall be done by the General Contractor. See Section 09 91 23 – Interior Painting.

B. All piping in all equipment rooms shall be identified with pipe markers with directional arrows. The following color code shall be followed.

LEGEND	PIPING	DIRECTIONAL MARKER	BAND COLOR BACKGROUND
Domestic Water	Green	Black	White
Chilled Water	Blue	Black	White

Heating Hot Water Supply	Aluminum	Black	White
Heating Hot Water Return	Aluminum	Black	White
Condenser Water	Light Blue	Black	White

NOTE: On any asphalt finished surfaces, prime with one (1) coat of aluminum paint before final color. All piping and equipment tags must be verified with TGHS prior to ordering.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. All division 23 specification sections, drawings, and general provisions of the contract apply to work of this section, as do other documents referred to in this section.

1.2 SCOPE OF WORK

A. The Owner shall obtain the services of an independent Test and Balance (TAB) Company which specializes in the testing and balancing of heating, ventilating and air conditioning (HVAC) systems to test, adjust and balance all HVAC systems in the building(s).

B. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC systems as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results. The testing, adjusting and balancing agency shall act as a reporting agency; that is, list and report each piece of equipment as to identification number, manufacturer, model number, serial number, proper location, specified performance, and report actual performance of all equipment as found during testing. The report is intended to be used during the life of the building as a ready reference indicating original conditions, equipment components, etc.

C. Representatives of the Test and Balance Company shall visit the job site during installation of the HVAC equipment, piping and ductwork as required.

D. Upon completion of the HVAC system installation, the Test and Balance Company shall perform all required testing and balancing with the full cooperation of the Contractor and his Sub-contractors. The Contractor shall make changes and/or adjustments to the HVAC system components that are required by the Test and Balance Company to accomplish proper balancing. The TAB agency shall not supply or install any materials or balancing devices such as pulleys, drives, belts, etc. All of this work is by the Contractor and shall be performed at no additional cost to the Owner.

E. The test and balance report complete with a summary page listing all deficiencies shall be submitted to the Architect for review by his Mechanical Engineer. If the Mechanical Engineer agrees with the report, he shall sign it and return it to the Architect. The test and balance report must be complete and must be accepted by the Mechanical Engineer prior to acceptance of the project. Any outstanding test and balance items shall be placed on the punch list and a monetary value shall be assigned to them.

F. After all deficiencies have been corrected the Mechanical Engineer shall sign the testing and balancing report, and the Test and Balance Company shall supply four (4) copies of the final and complete report to the Architect for inclusion in the Operation and Maintenance Manuals.

G. The items requiring testing, adjusting, and balancing include (but are not restricted to) the following:

HYDRONIC SYSTEMS:	AIR SYSTEMS
Pumps	Supply Exhaust Fans
System Mains and Branches	Zone, Branch, & Main Ducts
Heat Exchangers	VAV System
Coils	Diffusers, registers, & grilles

Control Valves Coils

1.3 DEFINITIONS, REFERENCES, STANDARDS

A. All work shall be in accordance with the latest edition of the Associated Air Balance Council (AABC) National Standards or the latest standards of the National Environmental Balancing Bureau (NEBB). If these contract documents set forth more stringent requirements than the AABC National Standards or the NEBB Standards, these contract documents shall prevail.

1.4 QUALIFICATIONS

A. Agency Qualifications: The TAB Agency shall be a current member of the AABC or the NEBB and must be in good standing.

1.5 SUBMITTALS

A. Procedures and Agenda: The TAB agency shall submit the TAB procedures and agenda proposed to be used.

B. Sample Forms: The TAB agency shall submit sample forms, which shall include the minimum data required by the AABC National Standards or the NEBB Standards.

1.6 TAB PREPARATION AND COORDINATION

A. Shop drawings, submittal data, up-to-date revisions, change orders, fan curves, pump curves and other data required for planning, preparation, and execution of the TAB work shall be provided when available and no later than 30 days after the Designer has returned the final approved submittal data to the Contractor.

B. System installation and equipment startup shall be complete prior to the TAB agency's being notified to begin.

C. The building control system (BCS) contractor shall provide and install the control system, including all temperature, pressure and humidity sensors. These shall be calibrated for accurate control. If applicable, the BCS contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.

D. All test points, balancing devices, identification tags, etc., shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.

E. Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

1.7 REPORTS

A. Final TAB Report - The TAB agency shall submit the final TAB report for review by the Architect. On plans provided, all outlets, devices, HVAC equipment, etc., shall be identified (including manufacturer, model number, serial number, motor manufacturer, HP, drive type, fan and motor sheaves and belt number), along with a numbering system corresponding to report unit identification. The TAB agency shall submit an AABC "National Project Performance Guaranty" (or similar NEBB Guaranty) assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and AABC National Standards (or similar NEBB Standards). The Designer shall certify his approval on the Performance Guaranty.

B. Submit 4 copies of the Final TAB Report to the Architect for inclusion in the Operation and

Maintenance Manuals.

PART 2 INSTRUMENTATION

A. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC National Standards (or similar NEBB Standards).

PART 3 EXECUTION

3.1 GENERAL

A. The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC National Standards (or similar NEBB Standards). Adjustment tolerances shall be + or - 10% unless otherwise stated.

B. Equipment settings, including manual damper quadrant positions, valve indicators, fan speed control levers, and similar controls and devices shall be marked to show final settings.

C. All information necessary to complete a proper TAB project and report shall be per AABC or NEBB standards unless otherwise noted. The descriptions of work required, as listed in this section, are a guide to the minimum information needed.

D. TAB contractor shall cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. Upon completion, patch insulation, ductwork and housings using materials identical to those removed. Seal insulation to reestablish integrity of the vapor barrier.

E. TAB work shall include additional inspection and adjustment of components during the season following the initial balance to include re-balance of any items influenced by seasonal changes or as directed by the architect.

3.2 AIR SYSTEMS

A. The TAB agency shall verify that all ductwork, splitters, extractors, dampers, grilles, registers, and diffusers have been installed per design, are functional and set full open. Any leakage in the ductwork shall be repaired prior to the test. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards or NEBB Standards:

For supply exhaust fans:

1. Fan speeds - Test and adjust fan RPM to achieve design CFM requirements.
2. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
3. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main supply and return ducts, as applicable to obtain total CFM. If a Pitot-tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet.
4. Outside Air - Test and adjust the outside air on applicable equipment using a Pitot-tube traverse. If a traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. If a traverse is not practical use the mixed-air temperature method if the inside and outside temperature difference is at least 20 degrees Fahrenheit or use the difference between Pitot-tube traverses of the supply and return air ducts.

5. Static Pressure - Test and record system static pressure, including the static pressure profile of each supply fan.

For exhaust fans:
1. Fan speeds - test and adjust fan RPM to achieve design CFM requirements.
2. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
3. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main exhaust ducts to obtain total CFM. If a Pitot-tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet.
4. Static Pressure - Test and record system static pressure, including the static pressure profile of each exhaust fan.

For zone, branch and main ducts:
1. Adjust ducts to within design CFM requirements. As applicable, at least one zone balancing damper shall be completely open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.

For VAV systems:
1. Identify the type, location, and size of each terminal box. This information shall be recorded on terminal box data sheets.
2. Test, adjust and record the maximum and minimum box air quantities for each VAV box.
3. Set volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
4. Test and record entering and leaving air temperature of hot water coils with full heating air flow and water flow.
5. Insure the entering static pressure is sufficient for normal, proper box operation.

For diffusers, registers and grilles:
1. Tolerances - Test, adjust, and balance each diffuser, grille, and register to within 10% of design requirements. Minimize drafts. Include required CFM, initial test CFM and final CFM.
2. Identification - Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.

For coils:
1. Air Temperature - Once air flows are set to acceptable limits, take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.

3.3 HYDRONIC SYSTEMS

A. The TAB agency shall, as applicable, verify that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; and that all balancing valves (except bypass valves) are set full open. Examine water in system and determine if it has been treated and cleaned. As applicable, it shall check air vents and expansion or compression tank for proper operation. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards (or similar NEBB Standards):

For pumps:
1. Test and adjust, hot water, pump to meet design GPM requirements. Check pump rotation and verify impeller size. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-Off/Dead head calculations. List pump N.P.S.H. (as applies).
2. Current and Voltage - Test and record motor voltage and amperage, and compare

data with the nameplate limits to ensure pump motor is not in or above the service factor.

For system mains and branches:
1. Adjust water flow in pipes to within design GPM requirements. As applicable, at least one branch balancing valve shall be completely open.

For heat exchangers:
1. Verify that heat exchangers have been filled and started by others, and are in operation.
2. Current and Voltage - As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
3. Test and adjust water flow through heat exchangers.
4. Test and record entering and leaving temperature and pressure profiles of water or steam heat exchangers.

For coils:
1. Tolerances - Test, adjust, and balance all chilled-water and hot-water coils within 10% of design requirements.
2. Verification - Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.

For control valves:
1. Check operation of automatic valves.
2. Test and record pressure drop and flow across control valves at full flow.

3.4 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
   1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
   2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
   3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
   4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
   5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
   6. Capacity: Calculate in tons of cooling.

3.5 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blow down systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
   1. Measure condenser-water flow to each cell of the cooling tower.
   2. Measure entering- and leaving-water temperatures.
   3. Measure wet- and dry-bulb temperatures of entering air.
   4. Measure wet- and dry-bulb temperatures of leaving air.
   5. Measure condenser-water flow rate recirculating through the cooling tower.
   6. Measure cooling tower pump discharge pressure.
   7. Adjust water level and feed rate of makeup-water system.

3.6 ADDITIONAL TAB SERVICES

A. Job Site Inspections: During construction, the TAB agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems as required.

B. Verification of HVAC Controls: The TAB agency shall be assisted by the building control systems Contractor in verifying the operation and calibration of all HVAC and temperature control systems. The following tests shall be conducted:
   1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, and other safety devices.
   2. Verify that all controlling instruments are calibrated and set for design operating conditions.

C. Temperature Testing: To verify system control and operation, a series of three temperature tests shall be taken at approximately two hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than two degrees Fahrenheit from the thermostat or control set point during the tests. Outside temperature and humidity shall also be recorded during the testing periods.

D. TAB Report Verification: At the time of final inspection, the TAB agency may be required to recheck, in the presence of the owner's representative, specific and random selections of data, air quantities, and air motion recorded in the certified report. Points and areas for recheck shall be selected by the owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, will not exceed 10% of the total number tabulated in the report.

END OF SECTION 23 05 93

SECTION 23 07 00 - PIPING AND EQUIPMENT INSULATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. Piping Insulation

B. Jackets and Accessories

C. Equipment Insulation

D. Duct Insulation

1.2 RELATED WORK

A. Section 23 31 00 – Ductwork

B. Section 22 10 00 – Plumbing Piping

1.3 REFERENCES

A. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation

B. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

C. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate

D. ASTM E845 - Surface Burning Characteristics of Building Materials.

E. NFPA 255 - Surface Burning Characteristics of Building Materials.

F. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 QUALITY ASSURANCE

A. Applicator: Company specializing in application of piping insulation.

B. Materials: Flame spread/fuel contributed/smoke developed rating of 25/50/50 in accordance with ASTM E84, NFPA 255.0, UL 723.

1.5 SUBMITTALS

A. Submit product data for each application as per Section 01 30 00– Administrative Requirements.

B. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 INSULATION

A. After all work has been tested and found to be leak free and tight, and accepted by the Architect, insulate as follows:

1. All chilled water, supply and return, piping above ground shall be covered with 2" thick molded cellular foam, foamglas or cell-u-glass type sectional pipe covering to be complete with F.R.J. jacket, with the exception of hot water run-outs - see item No. 2. Sections of covering shall be joined together, the mastic to be buttered on only one of the two adjoining surfaces at both the longitudinal and circumferential joints so that a complete seal at the joints is obtained. The piping insulation is to be secured in place with copper wire spaced not more than 12" on center.
2. All heating water, supply and return, piping above ground shall be covered with 2” thick rigid fiberglass type sectional pipe covering to be complete with F.R.J. jacket, with the exception of hot water run-outs – be 1” rigid fiberglass. Sections of covering shall be joined together, the mastic to be buttered on only one of the two adjoining surfaces at both the longitudinal and circumferential joints so that a complete seal at the joints is obtained. The piping insulation is to be secured in place with copper wire spaced not more than 12” on center.
3. All domestic hot and cold piping above ground shall be covered with 1" thick fiberglass, molded type sectional pipe covering complete with FRJ jacket. Sections of pipe covering shall be joined together, the mastic to be buttered on only one of the two adjoining surfaces at both the Longitudinal and circumferential joints so that a complete seal at the joints is obtained. The piping insulation will be secured in place with copper wire spaced not more than 12 on center. All domestic water piping insulation shall be continuous. Contractor shall not cut insulation to fit around structural items. No exceptions.
4. Insulate the square to round connections on each air handling unit with 3" thick 3/4 lb. density insulation board using stick pins randomly spaced 18" apart. Insulation board shall have aluminum vapor barrier.
5. Fittings, flanges, valves, etc., shall be covered with molded or fabricate covers of same material as pipe covering and shall be finished with two (2) coats of white vapor barrier mastic reinforced with 20-20 mesh glass fabric.
6. Insulate all VAV boxes, rectangular supply, return, exhaust, and fresh air ducts with 3" thick 3/4 lb. density fiberglass insulation with reinforced aluminum vapor barrier. Seal all joints with duct tape.
7. All round and flat oval supply return and exhaust air ducts shall be wrapped with 3" thick, 3/4 lb. density fiberglass insulation with reinforced aluminum vapor barrier. Seal all joints with 2" duct tape.
8. Insulate cooling coil condensate drain lines from air handling units with 1/2“ thick aerotube type insulation tied on and sealed over with tape.
9. Insulate back of all ceiling diffusers with 3" thick fiberglass with reinforced aluminum vapor barrier.
10. All chilled heating and water valves, and hot water pumps shall be insulated with a factory fabricated removable cover. Cover shall be fabricated of 1" close cell elastomeric insulation complete with Velcro closures.
11. Insulate all horizontal roof drains with 2” thick ¾ lb. density fiberglass insulation with reinforced aluminum vapor barrier. Seal all joints with duct tape.
12. All outdoor mechanical piping shall be covered with aluminum jacket, water tight.
13. All external duct work must be externally insulated and double wall. Seal water tight.
14. All exterior ductwork and ductwork run in attic spaces shall be wrapped with 3” thick, 3/4 lb. density fiberglass insulation with reinforced aluminum vapor barrier.
15. Insulate all PVC piping located in a return air plenum with 2” thick ¾ lb. density fiberglass insulation with reinforced aluminum vapor barrier. Seal all joints with duct tape.
16. All hydronic piping in mechanical room and any interior exposed piping shall have color coded PVC jacket watertight. Color to be coordinated with Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Install materials in accordance with manufacturer's instructions.

3.2 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Continue insulation with vapor barrier through penetrations.

C. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

D. Neatly finish insulation at supports, protrusions, and interruptions.

END OF SECTION 23 07 00

SECTION 23 08 10 - MECHANICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The purpose of this section is to specify Division 23 responsibilities in the commissioning process.

B. The systems to be commissioned are listed in Section 01 91 13.1.7.

C. Commissioning requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Division 01 91 13. Division 23 shall be familiar with all parts of Division 01 91 13 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2 RESPONSIBILITIES

A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

1. Include the cost of commissioning in the contract price.

2. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.

3. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.

4. Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment.

5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.

    a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

    b. The Commissioning Agent may request further documentation necessary for the commissioning process.

    c. This data request may be made prior to normal submittals.

6. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CxA for review and approval.

7. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

8. Provide limited assistance to the CxA in preparing the specific functional performance test procedures as specified in Section 23 08 11. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

9. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the CxA for all commissioned equipment. Submit to CxA for review and approval prior to startup. Refer to Section 01 91 13 for further details on start-up plan preparation.

10. During the startup and initial checkout process, execute the mechanical-related portions of the pre-functional checklists for all commissioned equipment.

11. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

12. Address current A/E punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air related systems.

13. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

14. Provide skilled technicians to perform functional performance testing under the direction of the CxA for specified equipment in Section 23 08 11 and 01 91 13. Assist the CxA in interpreting the monitoring data, as necessary.

15. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, CM and A/E and retest the equipment.

16. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

17. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).

18. Provide training of the Owner's operating staff using expert qualified personnel, as specified.

19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Mechanical Contractor. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all HVAC equipment, except for the building automation control system.

2. Assist and cooperate with the TAB contractor and CxA by:

   a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

   b. Including cost of sheaves and belts that may be required by TAB.

   c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.

   d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

3. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.

4. Notify the PM or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the PM or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

C. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:

   a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.

   b. All interactions and interlocks with other systems.

   c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.

   d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).

   e. Start-up sequences.

   f. Warm-up mode sequences.

   g. Normal operating mode sequences.

   h. Unoccupied mode sequences.

   i. Shutdown sequences.

   j. Capacity control sequences and equipment staging.

k. Temperature and pressure control: setbacks, setups, resets, etc.

l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.

m. Sequences for all alarms and emergency shut downs.

n. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.

o. Schedules, if known.

p. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

2. Control Drawings Submittal

a. The control drawings shall have a key to all abbreviations.

b. The control drawings shall contain graphic schematic depictions of the systems and each component.

c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.

d. Provide a full points list with at least the following included for each point:

1) Controlled system

2) Point abbreviation

3) Point description

4) Display unit

5) Control point or setpoint (Yes / No)

6) Monitoring point (Yes / No)

7) Intermediate point (Yes / No)

8) Calculated point (Yes / No)

a) Key:

b) Point Description: DB temp, airflow, etc.

c) Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)

d) Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).

e) Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.

f) Calculated Point: "Virtual" point generated from calculations of other point values.

9) The Controls Contractor shall keep the CxA informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.

4. Assist and cooperate with the TAB contractor in the following manner:

   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).

   b. For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.

   c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB or provide sufficient training for TAB to operate the system without assistance.

5. Assist and cooperate with the CxA in the following manner:

   a. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system as specified for the controls contractor in Section 23 08 11 and 26 08 11. Assist in the functional testing of all equipment specified in Section 23 08 11 and 26 08 11. Provide two-way radios during the testing.

   b. Execute all control system trend logs specified in Section 23 08 11 and 26 08 11.

6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, according to the process in Section 01 91 13. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:

   a. System name.

   b. List of devices.

   c. Step-by-step procedures for testing each controller after installation, including:

      1) Process of verifying proper hardware and wiring installation.

      2) Process of downloading programs to local controllers and verifying that they are addressed correctly.

      3) Process of performing operational checks of each controlled component.

      4) Plan and process for calibrating valve and damper actuators and all sensors.

      5) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

   d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has "passed" and is operating within the contract parameters.

e. A description of the instrumentation required for testing.

f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CxA and TAB contractor for this determination.

7. Provide a signed and dated certification to the CxA and PM upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.

8. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as specified in Section 23 09 00.

9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

D. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:

1. Six weeks prior to starting TAB, submit to the PM the qualifications of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Owner will approve the site technician's qualifications for this project.

2. Submit the outline of the TAB plan and approach for each system and component to the CxA, PM and the controls contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.

3. The submitted plan will include:

a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.

b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.

c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

e. Final test report forms to be used.

f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.

g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

h. Details of how *total* flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).

i. The identification and types of measurement instruments to be used and their most recent calibration date.

j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.

k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.

l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).

m. Details of how building static and exhaust fan / relief damper capacity will be checked.

n. Proposed selection points for sound measurements and sound measurement methods.

o. Details of methods for making any specified coil or other system plant capacity measurements.

p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.

q. Details regarding specified deferred or seasonal TAB work.

r. Details of any specified false loading of systems to complete TAB work.

s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.

t. Details of any required interstitial cavity differential pressure measurements and calculations.

u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

v. Plan for formal progress reports (scope and frequency).

w. Plan for formal deficiency reports (scope, frequency and distribution).

4. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CxA and PM at least twice a week.

5. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.

6. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CxA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111.

7. Provide the CxA with any requested data, gathered, but not shown on the draft reports.

8. Provide a final TAB report for the CxA with details, as in the draft.

9. Conduct functional performance tests and checks on the original TAB as specified for TAB in Section 23 08 11.

E. Mechanical Designer. Refer to Section 01 91 13 for the responsibilities of the mechanical designer.

1.3 RELATED WORK

A. Refer to Section 01 91 13, Part 1.5 for a listing of all sections where commissioning requirements are found.

B. Refer to Section 01 91 13 Part 1.7 for systems to be commissioned and section 01 91 13 Part 1.6 and 23 08 11 for functional testing requirements.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Division 23 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 01 91 13 Part 2.1 for additional Division 23 requirements.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Division 23 shall provide submittal documentation relative to commissioning as required in this Section Part 1, Section 01 33 01 and Section 01 91 13.

3.2 STARTUP

A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 91 13. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and PM. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.3 TAB

A. Refer to the TAB responsibilities in Part 1.2 above.

3.4 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 91 13 Part 1.7 for a list of systems to be commissioned and to Part 3.6 for a description of the process and to Section 23 08 11 for specific details on the required functional performance tests.

3.5 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Refer to Section 01 91 13 Part 3.4 for specific details on non-conformance issues relating to pre-functional checklists and tests.

B. Refer to Section 01 91 13 Part 3.7 for issues relating to functional performance tests.

3.6 OPERATION AND MAINTENANCE (O&M) MANUALS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.

B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the GC for inclusion in the O&M manuals, according to this section and Section 01 78 23, prior to the training of owner personnel.

C. The CxA shall receive a copy of the O&M manuals for review.

D. Special Control System O&M Manual Requirements. In addition to documentation that may be specified elsewhere, the controls contractor shall compile and organize at minimum the following data on the control system in labeled 3-ring binders with indexed tabs.

1. Three copies of the controls training manuals in a separate manual from the O&M manuals.

2. Operation and Maintenance Manuals containing:

a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.

b. Full as-built set of control drawings (refer to Submittal section above for details).

c. Full as-built sequence of operations for each piece of equipment.

d. Full points list. In addition to the updated points list required in the original submittals (Part 1 of this section), a listing of all rooms shall be provided with the following information for each room:

1) Floor

2) Room number

3) Room name

4) Air handler unit ID

5) Reference drawing number

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Full as-built print out of software program.

g. Electronic copy on disk of the entire program for this facility.

h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.

j. Control equipment component submittals, parts lists, etc.

k. Warranty requirements.

l. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).

3. The manual shall be organized and subdivided with permanently labeled tabs for each of the following data in the given order:

a. Sequences of operation

b. Control drawings

c. Points lists

d. Controller / module data

e. Thermostats and timers

f. Sensors and DP switches

g. Valves and valve actuators

h. Dampers and damper actuators

i. Program setups (software program printouts)

4. Field checkout sheets and trend logs should be provided to the CxA for inclusion in the Commissioning Record Book.

E. Special TAB Documentation Requirements. The TAB will compile and submit the following with other documentation that may be specified elsewhere in the *Specifications.*

1. Final report containing an explanation of the methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.

2. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

F. Review and Approvals. Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CxA. Refer to Section 01 91 13, Part 3.8 for details.

3.7 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01 91 13 for additional details.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 01 91 13 for additional details.

C. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01 91 13, Part 3.9.

2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to air conditioning units, air handling units, fans, fan coil units, controls and water treatment systems, etc.

3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

8. Training shall include:

    a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

    b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

    c. Discussion of relevant health and safety issues and concerns.

    d. Discussion of warranties and guarantees.

    e. Common troubleshooting problems and solutions.

    f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

    g. Discussion of any peculiarities of equipment installation or operation.

    h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.

10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.

11. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

12. Duration of training as necessary to properly train owner's staff.

D. Controls Contractor. The controls contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan four weeks before the planned training according to the outline described in Section 01 91 13, Part 3.9.

2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.

3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals *and* in all software displays. Manuals will be approved by the CxA. Copies of audiovisuals shall be delivered to the Owner.

4. The trainings will be tailored to the needs and skill-level of the trainees.

5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.

6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

7. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

8. There shall be two training sessions:

    a. Training I. Control System. The first training shall consist of 4 hours of actual training. This training may be held on-site. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.

    b. Training II. Building Systems. The second session shall be held on-site for a period of 4 hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:

        1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed systems.

        2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.

        3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.

        4) Every screen shall be completely discussed, allowing time for questions.

        5) Use of keypad or plug-in laptop computer at the zone level.

6) Use of remote access to the system via phone lines or networks.

7) Setting up and changing a fan coil unit controller.

E. TAB The TAB contractor shall have the following training responsibilities:

1. TAB shall meet for ___2____ hours with facility staff after completion of TAB and instruct them on the following:

a. Go over the final TAB report, explaining the layout and meanings of each data type.

b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.

c. Identify and discuss any duct runs, diffusers, coils and fans that are close to or are not meeting their design capacity.

d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.

e. Other salient information that may be useful for facility operations, relative to TAB.

3.8 DEFERRED TESTING

A. Refer to Section 01 91 13, Part 3.10 for requirements of deferred testing.

3.9 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the start-up and initial checkout plan described in Section 01 91 13 and the filled out start-up, initial checkout and pre-functional checklists.

END OF SECTION

SECTION 23 08 11 - MECHANICAL TESTING REQUIREMENTS

PART 1 - GENERAL

1.1 INCLUDED SYSTEMS AND EQUIPMENT

A. The following is a list of the equipment and system test requirements included in this section:

1)Air Handling Unit

2)Chilled Water System

3)Building Automation System

4)Domestic Hot Water System

5)Exhaust Fans

6)Heating Hot Water System

1.2 DESCRIPTION

A. This section specifies the functional testing requirements for Division 23 systems and equipment. From these requirements, the Commissioning Authority (CxA) shall develop step-by-step procedures to be executed by the Subs or the Commissioning Authority. The general functional testing process, requirements and test method definitions are described in Section 01 91 13. The test requirements for each piece of equipment or system contain the following:

1. The contractors responsible to execute the tests, under the direction of the CxA.
2. A list of the integral components being tested.
3. Pre-functional checklists associated with the components.
4. Functions and modes to be tested.
5. Required conditions of the test for each mode.
6. Special procedures.
7. Required methods of testing.
8. Required monitoring.
9. Acceptance criteria.
10. Sampling strategies allowed.

1.3 PREREQUISITES

The following applicable generic prerequisite checklist items are required to be listed on each written functional test form and be completed and checked off by CxA prior to functional testing.

__ All related equipment has been started up and start-up reports and pre-functional checklists submitted and approved ready for functional testing:

__ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

_____ _____
Controls Contractor Signature or Verbal Date

__ All A/E punchlist items for this equipment corrected.

__ These functional test procedures reviewed and approved by installing contractor.

__ Safeties and operating ranges reviewed by the CxA.

__ Test requirements and sequences of operation attached.

__ Schedules and setpoints attached.

__ False loading equipment, system and procedures ready.

__ Sufficient clearance around equipment for servicing.

__ Record of all values for pre-test setpoints changed to accommodate testing has been made and a check box provided to verify return to original values (control parameters, limits, delays, lockouts, schedules, etc.).

__ Other miscellaneous checks of the pre-functional checklist and start-up reports completed successfully.

1.4 MONITORING

A. Monitoring is a method of testing as a stand-alone method or to augment manual testing.

B. All points listed in the required monitoring section of the test requirements which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CxA using dataloggers. At the option of the CxA, some control system monitoring may be replaced with datalogger monitoring. At the CxA's request, the controls contractor shall trend up to 20% more points than listed herein at no extra charge.

C. Hard copies of monitored data must be in columnar format with time down the left column and at least 5 columns of point values on the same page.

D. Graphical output is desirable, and will be required for all output, if the system can produce it.

PART 2 – PRODUCTS

-- NOT APPLICABLE --

PART 3 – EXECUTION

1. AIR HANDLER UNIT

A. Parties Responsible to Execute Functional Test
1. Controls contractor: operate the controls to activate the equipment.
2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
1. Air Flow Measuring Station

C. Prerequisites The applicable prerequisite checklist items listed in the beginning of Section 23 08 11 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the pre-functional checklists previously completed by the installer, before the beginning of functional testing.

D. Functions / Modes Required To Be Tested, Test Methods and Seasonal Test Requirements
The following testing requirements are in addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	Test Method Manual, Monitoring, Either or Both[3]	Required Seasonal Test[1]
General 1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Supply air, space temp and space humidity	Both	
3. Dehumidification functions / humidification functions	Both	
4. Damper interlocks including fire and smoke dampers	Manual	
5. Temperature difference across heating and cooling coils, if spec'd	Manual	
6. Verification of minimum OSA quantity	Either	
7. Night low and high limit, morning warmup cycle,	Either	
8. Verify TAB reported SF cfm with control system reading	Manual	
9. All alarms (low limits, freezestat, etc.)	Manual	
10. Sensor and actuator calibration checks on: SAT, OSAT, etc. economizer (EMS readout against hand-held calibrated instrument must be within 0.5°F for temps. or within a tolerance equal to 10% of static pressure setpoint, with an inclined manometer)	Manual	
11. Verify control strategies, schedules and setpoints to be reasonable and appropriate		

[1]Cooling season, Heating season or Both. "Design" means within 5°of season design (ASHRAE 2 1/2%), or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.

E. Special Procedures (other equipment to test with, etc.; reference to function ID)

F. Required Monitoring

1. All points listed below which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CA using dataloggers. Refer to the Monitoring section at the beginning of Section 23 08 11 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)
For each Unit being tested:				
HUM, SAT	5	5 days incl. weekend	Y	Y
Space Temp., Hum	5	5 days incl. weekend	Y	Y
O/A CFM	1	5 days incl. weekend	Y	Y
Outdoor Air Temp., Hum	5	5 days incl. weekend	Y	Y

Remarks:

G. Acceptance Criteria (referenced by function or mode ID)

1-11. For the conditions, sequences and modes tested, the system, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

2. AHU shall be able to maintain the SA temperature within 1.0F either side of the deadband of the current setpoint without excessive hunting.

H. Sampling Strategy for Identical Units

1. All identical AHU's over 15 tons shall not have any sampling--test all units. However, 25% of the units may have monitoring be the verification method for modes listed with Monitoring or Both as testing methods, with no less than three units being fully tested per the above requirements.
2. All AHU's shall be sampled:
   Randomly test at least 25% of each group of fan coil units per the above tests. In no case test less than three units in each group. If 25% of the units in the first sample fail the functional performance tests, test the remaining 50%, fully at the contractor's expense. This sampling applies to the testing subsections. That is, if calibration is off on more than 10% of the tested piece of equipment, then another sample shall have calibrations checked, but not all other tests need to be done on the second sample.
3. All units not included in the sampling testing and monitoring shall be fully monitored for the monitoring modes listed above in the monitoring section.

END OF REQUIREMENTS FOR AIR HANDLING UNIT TEST

2. CHILLED WATER SYSTEM

100% of condenser water system shall be verified to maintain proper control. Specific test requirements for this may have been identified elsewhere in this specification. For all areas not specifically specified, otherwise, the following tests shall be conducted.

A. Parties Responsible to Execute Functional Test
1. Controls contractor: operate the controls and provide trend logs
2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
1. Control system

C. Prerequisites All listed systems in Part B, above, shall have had successful functional tests completed prior to this test.

D. Functions / Modes Required To Be Tested, Test Methods and Seasonal Test Requirements

This is a performance test to verify that the chilled water system can provide and maintain the cooling water as specified, during normal and extreme weather and occupancy conditions. The test consists of monitoring, via trend logs, of various points during the cooling season.

E. Special Procedures (other equipment to test with, etc.; reference to function ID)
1. None

F. Required Monitoring
1. All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 11 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
Chilled Water Supply Prim.	5	5 days incl. weekend	Y	Y	1,2
Chilled Water Return Prim.	5	5 days incl. weekend	Y	Y	1,2
Chilled Water Supply Sec.	5	5 days incl. weekend	Y	Y	1,2
Chilled Water Return Sec.	5	5 days incl. weekend	Y	Y	1,2
Chilled Water Sec. VFD	1	5 days incl. weekend	Y	Y	1,2
Chilled Water DP	1	5 days incl. weekend	Y	Y	1,2
DP Setpoint	1	5 days incl. weekend	Y	Y	1,2
Cond. Water Supply	5	5 days incl. weekend	Y	Y	1,2
Cond. Water Return	5	5 days incl. weekend	Y	Y	1,2
Tower Fan VFD	5	5 days incl. weekend	Y	Y	1,2
Chiller Status	COV	5 days incl. weekend	Y	Y	1,2

Remarks:

END OF REQUIREMENTS FOR CHILLED WATER SYSTEM

3. BUILDING AUTOMATION SYSTEM (BAS)

A. Parties Responsible to Execute Functional Test
1. Controls contractor: operate the controls to activate the equipment.
2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
1. Building Automation System
2. All pre-functional checklists of controlled equipment

D. Prerequisites The applicable prerequisite checklist items listed in the beginning of Section 23 08 11 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the pre-functional checklists previously completed by the installer, before the beginning of functional testing.

E. A significant part of the BAS functional testing requirements is the successful completion of the functional tests of equipment the BAS controls or interlocks with. Uncompleted equipment functional tests or outstanding deficiencies in those tests lend the required BAS functional testing incomplete.

F. Integral or stand-alone controls are functionally tested with the equipment they are attached to, including any interlocks with other equipment or systems and thus are not covered under the BAS testing requirements, except for any integrated functions or interlocks listed below.

G. In addition to the controlled equipment testing, the following tests are required for the BAS, where features have been specified. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in the specifications.

Function / Mode	**Test Method Manual (demonstration), Monitoring, Either or Both**
MISC. FUNCTIONS	
1. All specified functions and features are set up, debugged and fully operable	Verbal discussion of features
2. Power failure and battery backup and power-up restart functions	Demonstration
3. Specified trending and graphing features demonstration	See equipment trends
4. Global commands features	Demonstration
5. Security and access codes	Demonstration
6. Occupant over-rides (manual, telephone, key, keypad, etc.)	Demonstration
7. O&M schedules and alarms	Demonstration
8. Scheduling features fully functional and setup, including holidays	Observation in terminal screens or printouts
9. Date and time setting in central computer and verify field panels read the same time	Demonstration
10. Included features not specified to be setup are installed (list)	Demonstration
11. Override Push Button	Demonstration
12. Demonstrate functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad	Demonstration of 100% of panels and 10% of ports
13. All graphic screens and value readouts completed	Demonstration

Function / Mode	Test Method Manual (demonstration), Monitoring, Either or Both
14. Setpoint changing features and functions	Done during equipment testing
15. Communications to remote sites	Demonstration
16. Sensor calibrations	Sampled during equipment tests
17. Final as-builts or redlines (per spec) control drawings, final points list, program code, setpoints, schedules, warranties, etc. per specs, submitted for O&Ms.	Observation
18. Verify that points that are monitored only, having no control function, are checked for proper reporting to BAS.	Observation
INTEGRATED TESTS	
20. Fire alarm interlocks and response	Demonstration
21. Sequential staging ON of equipment	Either
22. Optimum start-stop functions	Monitoring
23. All control strategies and sequences not tested during controlled equipment testing	Either
24. Other integrated tests specified in the contract documents	
25. Security system interlocks	Demonstration
26. Fire protection and suppression systems	Demonstration

H. Special Procedures (other equipment to test with, etc.; reference to function ID)
None

I. Additional Required Monitoring
1. Besides the trending and monitoring required with the functional testing of equipment, all points listed below which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CA using dataloggers. Refer to the Monitoring section at the beginning of Section 23 08 11 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)	Function Being Tested
Optimum start/stop equip.	5	5 days incl. weekend	Y	Y	24

Remarks:

I. Acceptance Criteria (referenced by function or mode ID)
All For the conditions, sequences and modes tested, the BAS, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

J. Sampling Strategy for Identical Units
1. Sample 10% of the field panels for procedure 9, and 10% of the local ports for procedure 12. If 10% fail, test another 10%. If 10% of those fail, test all remaining units at the contractor's expense.

END OF REQUIREMENTS FOR BAS TEST

4. DOMESTIC HOT WATER SYSTEM

100% of solar hot water system shall be verified to maintain proper control. Specific test requirements for this may have been identified elsewhere in this specification. For all areas not specifically specified, otherwise, the following tests shall be conducted.

A. Parties Responsible to Execute Functional Test
   1. Controls contractor: operate the controls and provide trend logs
   2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
   1. Control system

C. Prerequisites All listed systems in Part B, above, shall have had successful functional tests completed prior to this test.

D. Functions / Modes Required To Be Tested, Test Methods and Seasonal Test Requirements

   This is a performance test to verify that the domestic hot water system can provide and maintain the domestic hot water as specified, during normal and extreme weather and occupancy conditions. The test consists of monitoring, via trend logs, of various points during the heating or cooling season.

E. Special Procedures (other equipment to test with, etc.; reference to function ID)
   1. None

F. Required Monitoring
   1. All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 11 for additional monitoring details.'

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)
Flow Switch	5	5 days incl. weekend	Y	Y
Isolation Valve	5	5 days incl. weekend	Y	Y
Domestic Hot Water Supply	5	5 days incl. weekend	Y	Y
Domestic Hot Water Return	1	5 days incl. weekend	Y	Y
Outdoor Air Temp.	1	5 days incl. weekend	Y	Y
Domestic Hot Water Setpoint	1	5 days incl. weekend	Y	Y

END OF REQUIREMENTS FOR DOMESTIC HOT WATER SYSTEM

5. EXHAUST FANS

The testing requirements apply to the following fans: Shop Exhaust Fans

A. Parties Responsible to Execute Functional Test
   1. Controls contractor: operate the controls to activate the equipment, if BAS controlled.
   2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
   1. Exhaust fans

C. Prerequisites The applicable prerequisite checklist items listed in the beginning of Section 15997 shall be listed on each functional test form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the pre-functional checklists previously completed by the installer, before the beginning of functional testing.

D. Functions / Modes Required To Be Tested, Test Methods and Seasonal Test Requirements
The following testing requirements are in addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	Test Method Manual, Monitoring, Either or Both[1]	Required Seasonal Test
General 1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Verify Alarm		
3. Check TAB report record of air flow and compare to specifications	Review	

[1]Refer to Special Procedures

E. Special Procedures (other equipment to test with, etc.; reference to function ID)
None

F. Required Monitoring
   1. All points listed below which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CA using dataloggers. Refer to the Monitoring section at the beginning of Section 15997 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)
For each fan:				

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)	ASCII File? (Y/N)
Exhaust Fan Status	5	5 days incl. weekend	Y	Y

Remarks:

G. Acceptance Criteria (referenced by function or mode ID)

1-6. For the conditions, sequences and modes tested, the fans, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

H. Sampling Strategy for Identical Units of the same type and function, but different in size, are considered identical for sampling purposes.

1. Randomly test at least 10% of each group of identical equipment (the 1st sample). In no case test less than three units in each group. If 10% of the units in the first sample fail the functional performance tests, test another 10% of the group (the 2nd sample). If 10% of the units in the 2nd sample fail, test all remaining units in the whole group, fully at the contractor's expense. This sampling applies to the testing subsections. That is, if calibration is off on more than 10% of the tested piece of equipment, then another sample shall have calibrations checked, but not all other tests need to be done on the second sample.

END OF REQUIREMENTS FOR EXHAUST FAN TEST

6. HEATING HOT WATER SYSTEM

100% of hot water system shall be verified to maintain proper control. Specific test requirements for this may have been identified elsewhere in this specification. For all areas not specifically specified, otherwise, the following tests shall be conducted.

A. Parties Responsible to Execute Functional Test
   1. Controls contractor: operate the controls and provide trend logs
   2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
   1. Control system

C. Prerequisites All listed systems in Part B, above, shall have had successful functional tests completed prior to this test.

D. Functions / Modes Required To Be Tested, Test Methods and Seasonal Test Requirements

   This is a performance test to verify that the heating hot water system can provide and maintain the heating hot water as specified, during normal and extreme weather and occupancy conditions. The test consists of monitoring, via trend logs, of various points during the heating or cooling season.

E. Special Procedures (other equipment to test with, etc.; reference to function ID)
   1. None

F. Required Monitoring
   1. All points listed below which are control system monitored points shall be trended by the controls contractor. Refer to the Monitoring section at the beginning of Section 23 08 11 for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend	Hard Copy? (Y/N)
Flow Switch	5	5 days incl. weekend	Y
Isolation Valve	5	5 days incl. weekend	Y
Hot Water Supply	5	5 days incl. weekend	Y
Hot Water Return	1	5 days incl. weekend	Y
Outdoor Air Temp.	1	5 days incl. weekend	Y
Heating Hot Water Setpoint	1	5 days incl. weekend	Y

Remarks:

END OF REQUIREMENTS FOR HEATING HOT WATER SYSTEM

END OF SECTION

SECTION 23 08 12 - COMMISSIONING PRE-FUNCTIONAL CHECKLISTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section contains representative Pre-functional Checklists in a form format (PC).

B. The checklists contain items for Division 23 contractors to perform. On each checklist, a column is provided that should be filled out by the Contractor assigning responsibility for that line item to a trade.

C. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.

D. Refer to Section 01 91 13for additional requirements regarding pre-functional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigor and clarity shall be used. Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

Pre-functional Mechanical Checklist

Project : _SAMPLE

PC-_01_ AIR HANDLER UNIT, AHU – 11, 21, 31, 41

Components included: supply fans, coils, control valves, VFD, control dampers, safeties

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This pre-functional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ___ List attached.

_____ Mechanical Contractor	_____ Date	_____ Controls Contractor	_____ Date
_____ Electrical Contractor	_____ Date	_____ Sheet Metal Contractor	_____ Date
_____ TAB Contractor	_____ Date	_____ General Contractor	_____ Date

Pre-functional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contract.

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->	AHU-11	AHU-21	AHU-31	AHU-41	Contr.
Manufacturer's cut sheets					
Performance data (fan curves, coil data, etc.)					
Installation and startup manual					
Sequences and control strategies					
O&M manuals					

- *Documentation complete as per contract documents for given trade.....___ YES ___ NO*

3. Model verification AHU [Contr = _____]

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->		AHU-11	AHU-21	AHU-31	AHU-41	
Manuf.	1					
	2					
	3					
Model	1					
	2					
	3					
Serial #	3					
Capacity	1					
	2					
	3					
Volts/phase	1					
	3					

- *The equipment installed matches the specifications for given trade .....___ YES ___ NO*

- 3.Model verification VFD [Contr = _____]
- 1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->		AHU-11	AHU-21	AHU-31	AHU-41	
Manuf.	1					
	2					
	3					
Model	1					
	2					
	3					
Serial #	3					
Capacity	1					
	2					
	3					
Volts/phase	1					
	3					

- *The equipment installed matches the specifications for given trade .....___ YES ___ NO*

4. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag-->	**AHU-11**	**AHU-21**	**AHU-31**	**AHU-41**		**Contr.**
Cabinet and General Installation						
Permanent labels affixed, including for fans						

Check if Okay. Enter comment or note number if deficient.

Check > Equip Tag-	AHU-11	AHU-21	AHU-31	AHU-41		Contr.
Casing condition good: no dents, leaks, door gaskets installed						
Access doors close tightly - no leaks						
Boot between duct and unit tight and in good condition						
Vibration isolation equipment installed & released from shipping locks						
Maintenance access acceptable for unit and components						
Sound attenuation installed						
Thermal insulation properly installed and according to specification						
Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.)						
Clean up of equipment completed per contract documents						
Filters installed and replacement type and efficiency permanently affixed to housing--construction filters removed						
Valves, Piping and Coils (see full piping checklists)						
Pipe fittings complete and pipes properly supported						
Pipes properly labeled						
Pipes properly insulated						
Strainers in place and clean						
Piping system properly flushed						
No leaking apparent around fittings						
All coils are clean and fins are in good condition						
All condensate drain pans clean and slope to drain, per spec						
Valves properly labeled						
Valves installed in proper direction						
Controls properly located and secure (see attached control drawing)						
Motors: Efficiency verified.						
P/T plugs and isolation valves installed per drawings						
Fans and Dampers						
Supply fan and motor alignment correct						
Supply fan belt tension & condition good						
Supply fan protective shrouds for belts in place and secure						
Supply fan area clean						
Supply fan and motor properly lubricated						
Filters clean and tight fitting						
Filter pressure differential measuring device installed and functional (magnahelic, inclined manometer, etc.)						
Smoke and fire dampers installed properly per contract docs (proper location, access doors, appropriate ratings verified)						

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->	AHU-11	AHU-21	AHU-31	AHU-41		Contr.
All dampers close tightly						
All damper linkages have minimum play						
Low limit freeze stat sensor located to deal with stratification & bypass						
Ducts (preliminary check)						
Sound attenuators installed						
Duct joint sealant properly installed						
No apparent severe duct restrictions						
Turning vanes in square elbows as per drawings						
OSA intakes located away from pollutant sources & exhaust outlets						
Pressure leakage tests completed						
Branch duct control dampers operable						
Ducts cleaned as per specifications						
Balancing dampers installed as per drawings and TAB's site visit						
Electrical and Controls						
Pilot and service lights are in place and functioning						
Power disconnects in place and labeled						
All electric connections tight						
Proper grounding installed for components and unit						
Safeties in place and operable (Fan access kill switch, pressure relief door, Low limit thermostat, Water sensor, Duct mounted smoke detectors (supply & return)),						
Starter overload breakers installed and correct size						
Control system interlocks hooked up and functional						
All control devices, pneumatic tubing and wiring complete						
VFD						
VFD powered (wired to controlled equipment)						
VFD interlocked to control system						
All hardware, electrical and mechanical connections tight?						
Static pressure or other controlling sensor properly located and per drawings.						
Drive location not subject to excessive temperatures						
Drive location not subject to excessive moisture or dirt						
Drive size matches motor size						
Internal setting designating the model is correct						
Input of motor FLA represents 100% to 105% of motor FLA rating						
Appropriate Volts vs Hz curve is being used						

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->	AHU-11	AHU-21	AHU-31	AHU-41		Contr.
Accel and decel times are around 60-90 seconds, except for special applications. Actual decel = _____ Actual accel = _____						
Lower frequency limit at 25% for VAV fans. Actual = _____						
Upper frequency limit set at 100%, unless explained otherwise						
Unit is programmed with full written programming record on site						
TAB						
Installation of system and balancing devices to allow balancing to be completed per specifications and contract documents						
Final						
Smoke and fire dampers and unpowered TU's are open						
Startup report completed with this checklist attached						
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent						
If unit is started and will be running during construction: have quality filters on RA grills, etc. to minimize dirt in the ductwork and coils and in any finished areas. Verify moisture migration is not a problem, due to improper pressures between spaces.						

- *The checklist items of Part 4 are all successfully completed for given trade.....___ YES ___ NO*
-

5. Operational Checks (This is not the functional performance testing.)

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->	AHU-11	AHU-21	AHU-31	AHU-41		Contr.
Supply fan rotation correct – VFD in Auto						
Supply fan rotation correct – VFD in Bypass						

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->	AHU-11	AHU-21	AHU-31	AHU-41		Contr.
Fans > 5 Hp Phase Checks (Measured at Full Speed): L1-L2 L2-L3 L3-L1 (%Imbalance = 100 x (avg. - lowest) / avg.) Record all 3 voltages in cell. Imbalance less than 2%?						
VFD Output Current (Measured at Full Speed): Phase A Phase B Phase C Record full load running amps for each fan. _____rated FL amps x _____srvc factor = _____ (Max amps). Running less than max?						
Output Current (Bypass): Phase A Phase B Phase C Record full load running amps for each fan. _____rated FL amps x _____srvc factor = _____ (Max amps). Running less than max?						
VFD is properly fused per the manual						
Supply fan has no unusual noise or vibration						
VFD is mounted per the Installation Manual.						
All dampers (OSA, RA, Fire/Smoke, etc.) stroke fully without binding and spans calibrated and BAS reading site verified (follow procedure in Calibration and Leak-by Test Procedures). List dampers checked: _____						
Valves stroke fully and easily and spanning is calibrated (follow procedure in Calibration and Leak-by Test Procedures). List each actuated valve here when spanned: _____						
Valves verified to not be leaking through coils when closed at normal operating pressure (follow procedure in Calibration and Leak-by Test Procedures).						
The HOA switch properly activates and deactivates the unit						
Specified sequences of operation and operating schedules have been implemented with all variations documented						
Specified point-to-point checks have been completed and documentation record submitted for this system						

- *The checklist items of Part 5 are all successfully completed for given trade.....___ YES ___ NO*

6. Sensor and Actuator Calibration [ ]

All field-installed temperature, relative humidity, CFM, CO_2, pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated using the methods and tolerances given in the Calibration and Leak-by Test Procedures document. All test instruments shall have had a certified calibration within the last 12 months: Y/N_____. Sensors installed *in* the unit at the factory with calibration certification provided need not be field calibrated.

AHU-11

Sensor or Actuator & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
RAT					
Space CO2					
SAT					
MAT					
Hot Water Valve					
Return Air Damper					

Sensor & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
Duct Static Pressure					
Outside Air CFM					
Return Air Humidity					
Chilled Water Valve					
Outside Air Damper					
Variable Frequency Drive					

Gage reading = reading of the permanent gage on the equipment. BAS = building automation system. Instr. = testing instrument. Visual = actual observation. The Contractor's own sensor check-out sheets may be used in lieu of the above, if the same recording fields are included and the referenced procedures are followed.

- *All sensors are calibrated within required tolerances.....___ YES ___ NO*

AHU-21

Sensor or Actuator & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
RAT					
Space CO2					
SAT					
MAT					
Hot Water Valve					

Sensor & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
Duct Static Pressure					
Outside Air CFM					
Return Air Humidity					
Chilled Water Valve					
Outside Air Damper					

Sensor or Actuator & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
Return Air Damper					

Sensor & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
Variable Frequency Drive					

Gage reading = reading of the permanent gage on the equipment. BAS = building automation system. Instr. = testing instrument. Visual = actual observation. The Contractor's own sensor check-out sheets may be used in lieu of the above, if the same recording fields are included and the referenced procedures are followed.

- *All sensors are calibrated within required tolerances.....___ YES ___ NO*

AHU-31

Sensor or Actuator & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
RAT					
Space CO2					
SAT					
MAT					
Hot Water Valve					
Return Air Damper					

Sensor & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
Duct Static Pressure					
Outside Air CFM					
Return Air Humidity					
Chilled Water Valve					
Outside Air Damper					
Variable Frequency Drive					

Gage reading = reading of the permanent gage on the equipment. BAS = building automation system. Instr. = testing instrument. Visual = actual observation. The Contractor's own sensor check-out sheets may be used in lieu of the above, if the same recording fields are included and the referenced procedures are followed.

- *All sensors are calibrated within required tolerances.....___ YES ___ NO*

AHU-41

Sensor or Actuator & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?

Sensor & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?

Sensor or Actuator & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
RAT					
Space CO2					
SAT					
MAT					
Hot Water Valve					
Return Air Damper					

Sensor & Location	Loc-ation OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?
Duct Static Pressure					
Outside Air CFM					
Return Air Humidity					
Chilled Water Valve					
Outside Air Damper					
Variable Frequency Drive					

Gage reading = reading of the permanent gage on the equipment. BAS = building automation system. Instr. = testing instrument. Visual = actual observation. The Contractor's own sensor check-out sheets may be used in lieu of the above, if the same recording fields are included and the referenced procedures are followed.

- *All sensors are calibrated within required tolerances.....___ YES ___ NO*

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

-- END OF CHECKLIST--

END OF SECTION

SECTION 23 08 13 - MECHANICAL FUNCTIONAL TEST PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section contains sample Functional performance Test procedures in a form format (FT).

1. The sample FT procedures displayed in a form format here are intended to provide the Subs and CA with an example of a format and an indication of the rigor of the required testing and documentation for various equipment types. They were not developed for this project. Other forms and formats are acceptable if they comply with the rigor, clarity and intent of all the commissioning specifications. The CA will use the functional testing requirements in Sections 23 08 11 and the testing protocols specified in Section 23 08 00 for developing site-specific functional test procedures and forms for this project. For illustrative purposes, sequences of operation associated with a few pieces of the equipment for which tests are included are also provided.

Functional Test

Project: Sample

FT-01 VAV AIR HANDLING UNIT AHU-01

And Associated Equipment

1. Participants

Party	Participation

Party filling out this form & witnessing _____ Date of test _____

2. Prerequisite Checklist

a. The following have been started up and startup reports and pre-functional checklists submitted and approved ready for functional testing:

__ Air Handler
__ Chilled Water System
__ Heating Hot Water System
__ Ductwork

b. __ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

_____ _____
Controls Contractor Signature or Verbal Date

c. __ All A/E punch list items for this equipment corrected.
d. __ These functional test procedures reviewed and approved by installing contractor.
e. __ Safeties and operating ranges reviewed.
f. __ Test requirements and sequences of operation attached.

g. __ False loading equipment, system and procedures ready (preheat or reheat coils, control loops, over-ride on OSA dampers, etc.)
h. __ Control Program Review. Review the software control program(s) for this equipment. Parameters, setpoints and logic sequences appear to follow the specified written sequences.
i. __ Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays, Lockouts, Schedules, Etc. Changed to Accommodate Testing:

Parameter	Pre-Test Values	Returned to Pre-Test Values √
Discharge Air Setpoint.		
Duct Static Pressure Setpoint		

Parameter	Pre-Test Values	Returned to Pre-Test Values √
Return air CO2 Setpoint		
Occupancy Schedule		

3. Verification of Misc. Pre-functional Checks.

Misc. site checks of the pre-functional checklist and startup reports completed successfully. Pass? Y / N _____

General Conditions of Test

_____
_____
_____

4. Functional Testing Record

Seq. ID From Specs [1]	Mode ID[2]	Test Procedure[3] (including special conditions)	Expected Response[4]	Pass Y/N	Note
1	FAN DOOR SWITCH	De-energize fan by turning HOA to OFF. Open fan access door. Turn HOA to Hand. Turn HOA to Auto. Repeat for each door fan kill switch on unit.	VFD should stay de-energized and show an alarm on the drive and at the GUI.		
2	FREEZE PROTECTION	With air unit fan off submerge freeze stat capillary tube in ice water (minimum of 1 foot) for a minimum of one minute. Remove capillary tube and close air unit doors. Turn HOA to Hand.	VFD should stay de-energized and show an alarm on the drive and at the GUI. Manually reset freezestat after test.		
3	SMOKE CONDITIONS	Interfacing with EC, simulate a fire mode with the Fire Alarm System	Verify that AHU System FAN is de-energized and that all smoke dampers are closed.		
4	SMOKE CONDITIONS	Interfacing with EC, clear fire mode with the Fire Alarm System	Verify that AHU System FAN is energized and that all smoke dampers are opened.		
5	EMERGENCY PAN WATER SENSOR	With air unit fan energized pour water in emergency pan to cover 18 inches (minimum) of the sensor rope.	VFD should stop and should show an alarm at VFD and GUI.		
6	FAN OFF	Standby Check. With Units Commanded off by BAS.	Verify by visual inspection that: Outside Air Dampers are closed. Return Air Dampers are open.		
7	UNIT STARTUP	With Units Commanded on by BAS	Fan ramps up slowly. Outside Air Dampers Open to their minimum positions. Chilled water valve modulates to maintain DAT at setpoint.		
8	CHILLED WATER VALVE CHECK	In cooling mode lower DAT setpoint to 3 deg. F below DAT.	Chilled water valve should be fully open.		
9	CHILLED WATER VALVE CHECK	In cooling mode raise DAT setpoint to 3 deg. F above DAT.	Chilled water valve should be fully closed.		

Seq. ID From Specs [1]	Mode ID[2]	Test Procedure[3] (including special conditions)	Expected Response[4]	Pass Y/N	Note
10	DEMAND CONTROL VENTILATION	Use test gas at 1000 ppm (or higher) on one CO2 space sensor.	Verify that controls are controlling CO2 from CO2 sensor with the highest CO2 level.		
11	DEMAND CONTROL VENTILATION	Reset CO2 setpoint to 150 ppm below actual.	Outside air damper should be at its maximum and return air dampers should be at its minimum. Verify maximum outside air CFM at GUI.		
12	DEMAND CONTROL VENTILATION	Reset CO2 setpoint to 150 ppm above actual.	Outside air damper should be at its minimum and return air dampers should be at its maximum. Verify minimum outside air CFM at GUI.		
13	STATIC PRESSURE CONTROL	Reset static pressure setpoint down by .5”WC.	Verify that the VFD modulates down. Verify at GUI that the new setpoint is maintained without hunting.		
14	STATIC PRESSURE CONTROL	Reset static pressure setpoint to down by 1.0”WC.	Verify that the VFD modulates up. Verify at GUI that the new setpoint is maintained without hunting.		
15	SUPPLY AIR RESET	Reset all VAV boxes on air unit to minimum demand for cooling.	Verify DAT setpoint reset to the high limit as shown at GUI.		
16	SUPPLY AIR RESET	Reset all VAV boxes on air unit to maximum demand for cooling.	Verify DAT setpoint reset to the low limit as shown at GUI.		
17	HIGH HUMIDITY OVERRIDE	Simulate high return air humidity above 52% RH.	Verify that DAT reset is disabled.		
18	OVER-RIDE	Schedule AHU to unoccupied. Push override button	Unit should energize when override push button is pushed.		
19	REVIEW	Review schedules, current setpoints and sequences with Specifications and Control Drawings prepared by CC	Submit approved differences to be incorporated into as-builts.		

Seq. ID From Specs [1]	Mode ID[2]	Test Procedure[3] (including special conditions)	Expected Response[4]	Pass Y/N	Note
20	TRENDING	Set all points to trend at the GUI	Print trends and submit to commissioning agent (2 weeks of data) Trend to begin following successful functional testing.		

Record Foot Notes
[1]Sequences of operation specified in Contract Documents (attached).
[2]Mode or function ID being tested from testing requirements section of the project Specifications.
[3]Step-by-step procedures for manual testing, trend logging or data-logger monitoring.
[4]Include tolerances for a passing condition.
[5]Record any permanently changed parameter values and submit to Owner.

A SUMMARY OF DEFICIENCIES IDENTIFIED DURING TESTING IS ATTACHED

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

-- END OF TEST --

END OF SECTION

SECTION 230900 - HVAC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 SCOPE

A. The existing Terrebonne General Health System (TGHS) Facility Management System (FMS) is a "Metasys" system manufactured by Johnson Controls, Inc. The FMS and automatic temperature controls for this facility is to interface completely with the existing FMS system. All features and functions of the present system shall be fully supported. It is the responsibility of the contractor to include all required equipment, hardware, licensed software, backup data storage, labor and programming to have a completely installed system. The furnishing and installing of all items required for the FMS and automatic temperature controls system shall be by the Temperature Controls System Installer (TCSI), for a complete and fully operational system. The owner is not responsible for furnishing any licensed software as part of this project. The FMS and automatic temperature controls system shall be complete in all respects including labor, materials, equipment, and services necessary. This system shall be installed and adjusted by mechanics regularly employed by the TCSI. All equipment shall be of the manufacturer's first quality and of the full proportioning type. The complete Temperature Control system shall be a DDC with electronic sensors and electric/electronic actuation of valves and dampers.

B. The existing TGHS FMS is Johnson Controls, Inc. (JCI) Metasys system. The FMS and all temperature controls for this project shall interface completely with the existing FMS. The FMS shall communicate to the system in the building shall be able to be complete for full control and time schedules. In addition, this system shall use the available campus master graphics package for floor-plan graphics required for this work. This graphics system exists on the workstations on campus. Any specific graphics required by this building, but not presently resident on the master graphics package, shall be created by this Contractor and added to master graphics package for universal use. The format and form of the graphics must match the color, size and format appearance of the existing graphics. Additional workstations, computers, integrators, and servers to facilitate connection to the existing FMS system are not acceptable. Web accessed monitoring and control separate from the existing FMS system licensed software are not permitted as they do not provide a seamless connection into the existing system.

C. All points and sequences described herein shall be incorporated into the existing FMS at TGHS's main system. All new points shall be made visible and totally controllable by all means allowable through all FMS computers. All existing graphics shall be updated to include this projects floor-plans, equipment and control points, to match existing floor-plan graphics utilized for other buildings on campus. Graphics shall be updated on all computers where graphics are located.

D. Uploads and downloads of controllers shall be able to be performed at any existing workstation or from any network panel. Twenty-four hour point history shall be available for all points simply by double clicking the mouse on designated point. Scheduling of any point on the system shall be available from any workstation. All workstations shall be updated to display new network maps with new buildings, equipment, and points.

E. Each primary device (air handler, VAV boxes etc) shall have individual controllers. Grouping of equipment on one controller will not be acceptable.

F. Installation of a new operator workstation, server, software (other than licensed updates noted below), programming tools, integrator panel and graphics package for this project is not acceptable.

G. Contractor shall be responsible for updating licensed software (to the current version) and programming, as applicable, setup of schedules, trends, logs and alarms and connections.

H. All wiring required in the control system and all interlocking motor control wiring and start-stop control wiring shall be furnished and installed as part of the work of this section of Division 23. The control system shall include all interconnecting wiring and conduit as required for a fully operational system as specified. All line voltage wiring and low voltage wiring shall utilize methods and materials complying with the requirements of the Electrical Specifications, Division 26.

I. The control system shall consist of all thermostats, valves, dampers, transformers, relays and other necessary equipment to provide controls for all phases of the cooling, heating and ventilating systems as required; refer to drawings for additional requirements.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Where work specified under other Sections of these Specifications connects to equipment or systems which are a part of this section, provide proper connection(s) to such equipment including trade coordination. The following sections may have direct links to the installation of the FMS system:
1. Section 230001 - General Conditions
2. Section 230113 – MISC. Mechanical Requirements
3. Section 233100 - Sheet Metal Work
4. Section 230503 - HVAC Piping
5. Section 232116 – Piping Specialties
6. Division 26 - Electrical Work
7. Additional related work as specified in Part 3 or as shown on the design drawings

1.3 QUALITY ASSURANCE

A. General:
1. The Facility Management System herein specified shall be fully integrated and installed as a complete package by the TCSI. The System shall include all wiring, piping, installation supervision, calibration, adjustments, and checkout necessary for a complete and fully operational system.
2. The TCSI shall be a factory authorized agency that is regularly engaged in the engineering, programming, installation and service of Facility Management Systems of similar size and complexity. The FMS supplier shall have a support facility within 25 miles of the site with technical staff, spare parts, and all necessary test/diagnostic equipment. The FMS supplier shall have a minimum of 10 years installation experience. Bids by wholesalers and non-franchised contractors shall not be acceptable.
3. The TCSI shall have a local branch facility. Emergency service shall be available on a 24-hour, 7-day-a-week basis.
4. The TCSI shall be responsible for all work fitting into place in a satisfactory and neat workmanlike manner acceptable to the Owner/Architect/Engineer.
5. The TCSI will coordinate with other trades regarding the location and size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, and so forth, in order to eliminate any delays in the progress of the job.

B. Experience Record:
1. The TCSI shall have experience with the complete, turnkey installation of Facility Management Systems of similar size and technical complexity.

2. The TCSI shall employ specialists in the field of Facility Management Systems including: Programming, Engineering, Field Supervision, and Installation. Specialists shall have experience with Facility Management Systems.

C. Products:

1. The Facility Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Facility Management Systems, and shall be the manufacturer's latest standard of design. Controllers and DDC (Direct Digital Control) system components shall be current production products.
2. All other equipment shall be the products of the FMS manufacturers or of an approved manufacturer regularly engaged in production of specialized Facility Management System materials or equipment.
3. Following is a list of acceptable Manufacturers: Johnson Controls, Inc. by local New Orleans branch office Contact Mike DiVincent @ 228-363-2238 or michael.divincent@jci.com.

1.4 WORK INCLUDED

A. Installation of Facility Management System (FMS):

1. The TCSI shall furnish and install a complete Facility Management System (FMS) for all mechanical systems and other facility systems as included in the project documents. The FMS will provide the functional features as defined in Part 1-General Requirements, Part 2-Products, and Part 3-Execution of these Specifications. The TCSI shall provide a complete and operational system to perform all sequences of operations stated within Part 3 or shown on the control drawings.
2. In addition, the following apply:
   a. The work under this Section shall include all materials and labor to perform all work required for the installation of the TCSI as specified.
   b. The drawings and Specifications are complementary to one another—meaning that what is called for on one is to be considered called for in both. Where conflicts exist between the Specifications and/or drawings, the more stringent requirement shall apply.
   c. The TCSI shall be responsible for field verification of site conditions and for gathering all necessary field data for all items to be provided under this contract prior to submitting his or her bid.
   d. Where work specified under other Sections of this Specification connects to equipment or systems that are listed and described in this Section, the TCSI shall provide proper connection(s) to such equipment, including trade coordination.

1.5 SUBMITTALS

A. Shop Drawings, Product Data, and Samples:

1. The TCSI shall submit within 60 days after award installation drawings and control strategies for review. During the submittal phase, the TCSI shall provide detailed diagrams to demonstrate the connection being used for communicating with the existing FMS Metasys system.
2. Each submittal shall have a cover sheet with the following information provided: submittal ID number; date; project name, address, and title; TCSI name, address and phone number; TCSI project manager, quality control manager, and project engineer names and phone numbers.
3. Each submittal shall include the following information.
   a. FMS riser diagram showing all DDC controllers, operator workstations, network repeaters, and network wiring.

b. One-line schematics and system flow diagrams showing the location of all control devices.
c. Points list for each DDC controller, including: Tag, Point Type, System Name, Object Name, Expanded ID, Display Units, Controller Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number.

4. Vendor's own written description for each sequence of operations, to include the following:
   a. Sequences shall reference input/output and software parameters by name and description.
   b. The sequences of operations provided in the submittal by the TCSI shall represent the detailed analysis needed to create actual programming code from the design documents.
   c. Points shall be referenced by name, including all software points such as programmable setpoints, range limits, time delays, and so forth.
   d. The sequence of operations shall cover normal operation and operation under the various alarm conditions applicable to that system.
   e. User interface functional outline. The outline shall include each display screen to be provided, data to be displayed, and links to other screens. The outline level hierarchy shall be:
      1) Site
      2) Building
      3) Floor
      4) System
   f. Detailed Bill of Material list for each panel, identifying: quantity, part number, description, and associated options.
   g. Control Valve Schedules. This spreadsheet type schedule shall include a separate line for each valve and a column for each of the valve attributes, including: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Calc CV, Design Pressure, Actual Pressure, and Actuator Type.
   h. Cataloged cut sheets of all equipment used. This includes, but is not limited to, the following: DDC panels, peripherals, sensors, actuators, dampers, control air system components, and so forth.
   i. Range and scale information for all transmitters and sensors. This sheet shall clearly indicate one device and any applicable options. Where more than one device to be used is on a single sheet, submit two sheets, individually marked.
   j. Hardware data sheets for all operator workstations, local access panels, and portable operator terminals.
   k. Licensed software manuals for all applications programs to be provided as a part of the operator workstations, portable operator terminals, programming devices, and so forth for evaluation for compliance with the performance requirements of this Specification.
   l. Initial project team Quality Assurance compliance report.
5. TCSI shall not order material or begin fabrication or field installation until receiving authorization to proceed in the form of an approved submittal. TCSI shall be solely responsible for the removal and replacement of any item not approved by submittal at no cost to the Owner.

1.6 O&M MANUALS

A. Submit three sets of each manual.

B. Include the following documentation in the Hardware Manual:
   1. General description and cut sheets for all components.
   2. Detailed wiring and installation illustrations and complete calibration procedures for each field and panel device.
   3. Complete trouble-shooting procedures and guidelines.
   4. Complete operating instructions for all systems.
   5. Maintenance Instructions: Document all maintenance and repair/replacement procedures.

C. Include the following documentation in the DDC Software Manual:
   1. Sequence of Operations
   2. Program Listing of Software Source Code OR Flow Chart Diagrams of Programming Objects.
   3. Printed listing of controller and operator workstation database files.
   4. Software Point Name Abbreviation List.. Include Name, Description, Controller Where Located, Point Type and Point ID.
   5. I/O Point List. Include Point Name, Controller Location, Point Number, Control Device, Range and Span.
   6. Printouts of all; Reports, Group Listings and Alarm Messages.
   7. Index of all DDC point names with documentation manual page number references.

D. Provide three copies of all manufacturers manuals covering the installed system. This shall include, as a minimum:
   1. System Engineering Manual
   2. System Installation Manual
   3. Programming Manual
   4. Engineering and Troubleshooting Bulletins
   5. Operator Workstation Licensed software Manual
   6. All other pertinent manuals published by the control system manufacturer.

E. All manuals shall be provided in hard copy format or on a single Compact Disk (CD) as part of an on-line documentation system through the operator workstation.

F. Record Drawings (i.e., control diagrams/schematics updated for As-Built conditions).

1.7 WARRANTY

A. Material: The Control System shall be free from defects in material and workmanship under normal use and service. If within twelve (12) months from the date of acceptance any of the equipment herein described is defective in operation, workmanship or materials, it will be replaced, repaired or adjusted at the option of the TCSI free of charge.

B. Installation: The Control System shall be free from defects in installation workmanship for a period of one year from acceptance. The TCSI shall, free of charge, correct any defects in workmanship within one week of notification in writing by the Owner.

PART 2 – PRODUCTS

2.1 GENERAL PRODUCT DESCRIPTION

A. The existing Metasys Facility Management System (FMS) shall integrate multiple building functions including equipment supervision and control, alarm management, energy management,

information management, and historical data collection and archiving. The use of additional servers, computers, and workstations is unacceptable. FMS licensed software shall be updated to latest version at project completion.

B. The facility management system shall consist of the following:
   1. Standalone Network Controllers
   2. Application specific controllers (HVAC etc.)
   3. Networked Thermostats

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, Network Controllers (see Network Controllers below), and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each Network Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Network Controllers shall be able to access any data from, or send control commands and alarm reports directly to any other Network Controller or combination of panels on the network without dependence upon a central processing device, such as a central file server. Network Controllers shall also be able to send alarm reports to multiple operator workstations, terminals, and printers without dependence upon a central processing device or File Server.

2.2 SYSTEM ARCHITECTURE AND NETWORK CONTROL PANELS

A. Network:
   1. The first tier network shall be based on a PC industry standard of Ethernet TCP/IP. PC Workstation LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.
   2. The FMS shall network multiple operator workstations, network controllers, system controllers, and application-specific controllers. The first tier network shall provide communications between operator workstations and first tier DDC (Direct Digital Control) controllers.
   3. All FMS devices on the network shall be capable of communicating at a communication speed of 100Mbps, with full peer to peer network communication.
   4. Network Controllers shall reside on the first tier.
   5. The first tier network will be compatible with other facility-wide networks. The first tier shall be connected to a facility network by way of standard networking practices.
   6. Second tier networks shall provide either “Peer-to-Peer,” Master-Slave, IEEE802.15.4, Supervised Token Passing communications, wireless, and shall operate at a minimum communication speed of 9600 baud.

B. Network Control Panel:
   1. The Network Control Panel (NCP) shall be a fully user-programmable, supervisory controller. The NCP shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
   2. Automation network – The NCP shall reside on the automation network and shall support a subnet of system controllers.
   3. User Interface (UI) – All computers connected physically or virtually to the automation network shall have access to the UI. Systems that require a local copy of the system

database on the user's personal computer are not acceptable. The NCP shall support concurrent users. The user shall have the capability to access all system data through one NCP. Systems that require the user to address more than one NCP to access all system information are not acceptable.

4. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
5. The UI shall support the following functions:
    a. Configuration
    b. Commissioning
    c. Data Archiving
    d. Monitoring
    e. Commanding
    f. System Diagnostics
6. Systems that require workstation software or modified web browsers are not acceptable.
7. The NCP shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
8. Processor – The NCP shall be microprocessor-based with a minimum word size of 32 bits. The NCP shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NCP size and capability shall be sufficient to fully meet the requirements of this Specification.
9. Memory – Each NCP shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
10. Hardware Real Time Clock – The NCP shall include an integrated, hardware-Based, real-time clock.
11. The NCP shall include troubleshooting LED indicators to identify the following conditions:
    a. Power - On/Off
    b. Ethernet Connection Speed – 10 Mbps/100 Mbps
    c. Peer Communication – Data Traffic between NCP Devices
    d. Run – NCP Running/NCP in Startup/NCP Shutting Down/Software Not Running
    e. Bat Fault – Battery Defective, Data Protection Battery Not Installed
    f. Fault – General Fault
12. Communications Ports – The NCP shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
    a. USB port
    b. RS-232 serial data communication port
    c. RS-485 port
    d. Ethernet port
13. Diagnostics – The NCP shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
14. Power Failure – In the event of the loss of normal power, The NCP shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
15. Certification – The NCP shall be listed by Underwriters Laboratories (UL).

2.3 OPERATOR INTERFACE – PLATFORMS - EXISTING

A. The present campus FMS has existing Metasys workstation(s) for command entry, information management, network alarm management, database management functions and all real-time control functions, including scheduling, history collection and alarming that shall be utilized for this project. Installation of a new PC workstation and/or new software for monitoring and controlling this building is not acceptable. Communication between building control panels and all workstations shall be over a high speed network. Application specific controllers shall be constantly scanned by the building's Network Control Panel(s) (NCP) to update point and alarm information. The Johnson Controls Metasys system (licensed software/hardware/graphics) shall remain in service and not be replaced and shall be updated to the current revision level at project completion.

B. TCSI shall update existing control application and graphics licensed software to include the new equipment and control points required for the equipment in this project. Provide dynamic floor-plan graphics for all systems.

2.4 DDC SYSTEM CONTROLLERS

A. Standalone DDC Panels:

1. Standalone DDC panels shall be microprocessor-based, multi-tasking, multi-user, real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. A sufficient number of controllers shall be supplied to fully meet the requirements of this Specification and the attached point list.
2. Point types – Each DDC panel shall support the following types of point inputs and outputs:
    a. Analog inputs shall monitor the following analog signals:
        1) 4-20 mA Sensors
        2) 0-10 VDC Sensors
        3) 1000ohm RTDs
    b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”
    c. Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.
    d. Analog outputs shall provide the following control outputs:
        1) 4.20 mA – Sink or Source
        2) 0-10 VDC
    e. Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.
    f. TriState outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.
    g. Pneumatic outputs shall provide a 3-15 PSI pneumatic output. Gradual override capability and output pressure gauge shall be provided.
3. All DDC controllers shall communicate via BacNet MSTP. Bacnet IP is not acceptable.

2.5 APPLICATION SPECIFIC CONTROLLERS

1. General Purpose Equipment Controller (CGM controllers)

a. The General Purpose Equipment Controller shall be a fully programmable, digital controller. The CGM communicates via the BACnet MS/TP protocol.

    i. The CGM shall support BACnet Standard ANSI/ASHRAE 135.

        - The CGM shall be BTL listed/certified.
        - The CGM shall be tested and certified as a BACnet Advanced Application Controller (B-AAC).
        - A BACnet Protocol Implementation Conformance Statement shall be provided for the CGM.
        - The Conformance Statement shall be submitted 10 days prior to bidding.

b. The CGM shall employ finite state programming to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
c. CGM controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
d. The CGM shall be assembled in a plastic housing with protection class IP20 (IEC529) and flammability rated to UL94-5VB.
e. The CGM shall include an integral real-time clock and support time-based tasks which enables these equipment controllers to monitor and control:

    i. Schedules
    ii. Calendars
    iii. Alarms
    iv. Trends

f. The CGM can continue time-based monitoring when offline for extended periods of time from a network.
g. The CGM can operate as a stand-alone controller in applications that do not require a networked supervisory device or for network applications where it is preferred to have the scheduling, alarming, and/or trending performed locally in the equipment controllers.
h. The CGM shall include troubleshooting LEDs to indicate the following conditions:

    i. Power – to indicate if the controller is powered or not powered
    ii. Fault – to indicate if the controller is in its default state, has no faults, has a device fault, is in startup or download mode, or has an SA Bus communication issue
    iii. SA Bus – to indicate if SA Bus communication is occurring and normal, is not occurring, or was occurring but has been lost and is waiting to rejoin
    iv. FC Bus – to indicate if FC Bus communication is occurring and normal, is not occurring, or was occurring but has been lost and is waiting to rejoin
    v. EOL – to indicate if the end-of-line termination switch is on or off

i. The CGM shall have the ability to transfer and apply firmware files to all SA Bus devices (XPM, IOM, and NS8000) connected to it.
j. The CGM shall include pluggable screw terminal blocks for all I/O, SA Bus communication, and power wiring connections. The CGM also includes a pluggable screw terminal block for FC bus communication.
k. The CGM shall accommodate the direct wiring of analog and binary I/O field points with the following resolution.

    i. Inputs – 24-bit analog-to-digital converter
    ii. Outputs – +/- 200 mV accuracy in 0-10 VDC applications

l. The CGM shall support the following types of inputs and outputs supplied in the amounts required for the specified applications:

   i. Universal Inputs – shall be configurable to monitor any of the following:

      - 0-10 VDC analog input
      - 4-20 mA analog input
      - 0-600k ohms analog input
      - Dry contact binary input

   ii. Binary Inputs – shall be configurable to monitor either of the following:

      - Dry Contact Maintained Mode
      - Pulse Counter Mode

   iii. Analog Outputs – shall be configurable to output either of the following:

      - 0-10 VDC analog output
      - 4-20 mA analog output

   iv. Binary Outputs – shall output the following:

      - 24 VAC Triac

   v. Configurable Outputs – shall be capable of the following:

      - 0-10 VDC analog output
      - 24 VAC Triac binary output

m. The CGM shall have the ability to reside on a Field Controller Bus (FC Bus).

   i. The FC Bus shall be a MS/TP Bus supporting BACnet Standard protocol SSPC-135.
   ii. The FC Bus shall support communications between the CGMs and the Network Engine.
   iii. The FC Bus shall also support peer-to-peer communications between non-supervisory devices, allowing these devices to communicate system data with each other directly, bypassing the supervisory network engine on the bus.
   iv. The FC Bus shall support a minimum of 100 equipment controllers and/or expansion modules in any combination.
   v. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the CGM and the furthest connected device.

n. The CGM shall include three (3) decimal rotary dial switches for setting the BACnet MS/TP device address.

o. The CGM shall have the ability to monitor and control a network of sensors and actuators over a SA Bus.

   i. The SA Bus shall be a MS/TP Bus supporting BACnet Standard Protocol SSPC-135.
   ii. The SA Bus shall support a minimum of 10 devices per trunk.
   iii. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the CGM/CGE and the furthest connected device.

p. The CGM shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over a MS/TP Bus.

q. The CGM shall support, but not be limited to, the following applications.

   i. Chilled central plant applications
   ii. Heating central plant applications.

iii. Built-up air handling units for special applications.
iv. Terminal & package units.
v. Special programs as required for systems control.

2. VAV Box Controller

a. The VAV Box Controller shall provide both standalone and networked DDC of pressure-independent, VAV terminal units.
b. The VAV Box Controller shall be a fully programmable, digital controller. The CVM communicates via BACnet MS/TP protocol. The CVE controller communicates via the BACnet/IP or BACnet/SC protocol.

iii. The CVM shall support BACnet Standard ANSI/ASHRAE 135.

- The CVM shall be BTL listed/certified.
- The CVM shall be tested and certified as a BACnet Advanced Application Controller (B-AAC).
- A BACnet Protocol Implementation Conformance Statement shall be provided for the CVM.
- The Conformance Statement shall be submitted 10 days prior to bidding.

c. The CVM shall include 14 preloaded single duct VAV box control applications to allow the controller to be made fully operational without the need to create a custom program.
d. The CVM shall employ finite state programming to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
e. CVM controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
f. The CVM shall be assembled in a plenum-rated plastic housing with protection class IP20 (IEC529) and flammability rated to UL94-5VB.
g. The CVM shall include an integral real-time clock and support time-based tasks which enables these equipment controllers to monitor and control:

i. Schedules
ii. Calendars
iii. Alarms
iv. Trends

h. The CVM can continue time-based monitoring when offline for extended periods of time from a network.
i. The CVM shall include an integral differential pressure transducer and damper actuator. An additional configuration option shall be available that also includes an integral potentiometer for actual damper position feedback. All components shall be connected and mounted as a single assembly, removable as one piece.
j. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 60 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
k. The CVM shall determine airflow by a state-of-the-art, digital, non-flow pressure sensor that supports automatic correction for polarity on high- and low-pressure DP tube connections to eliminate high- and low-pressure connection mistakes.
l. The CVM shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

m. The CVM can operate as a stand-alone controller in applications that do not require a networked supervisory device or for network applications where it is preferred to have the scheduling, alarming, and/or trending performed locally in the equipment controllers.
n. The CVM shall include troubleshooting LEDs to indicate the following conditions:

   i. Power – to indicate if the controller is powered or not powered
   ii. Fault – to indicate if the controller is in its default state, has no faults, has a device fault, is in startup or download mode, or has an SA Bus communication issue
   iii. SA Bus – to indicate if SA Bus communication is occurring and normal, is not occurring, or was occurring but has been lost and is waiting to rejoin
   iv. FC Bus – to indicate if FC Bus communication is occurring and normal, is not occurring, or was occurring but has been lost and is waiting to rejoin
   v. EOL – to indicate if the end-of-line termination switch is on or off

o. The CVM shall have the ability to transfer and apply firmware files to all SA Bus devices (XPM, IOM, and NS8000) connected to it.
p. The CVM shall include pluggable screw terminal blocks for all I/O, SA Bus communication, and power wiring connections. The CVM also includes a pluggable screw terminal block for FC bus communication.
q. The CVM shall accommodate the direct wiring of analog and binary I/O field points with the following resolution.

   iv. Inputs – 15-bit resolution on UIs
   v. Outputs – +/- 200 mV accuracy in 0-10 VDC applications

r. The CVM shall support the following types of inputs and outputs supplied in the amounts required for the specified applications:

   i. Universal Inputs – shall be configurable to monitor any of the following:

      - 0-10 VDC analog input
      - 4-20 mA analog input
      - 0-600k ohms analog input
      - Dry contact binary input

   ii. Binary Outputs – shall output the following:
      - 24 VAC Triac binary outputs
   iii. Configurable Outputs – shall be configurable of outputting the following:

      - 0-10 VDC analog output
      - 24 VAC Triac binary output

s. The CVM shall have the ability to reside on a Field Controller Bus (FC Bus).

   i. The FC Bus shall be a MS/TP Bus supporting BACnet Standard protocol SSPC-135.
   ii. The FC Bus shall support communications between the CVMs and the Network Engine.
   iii. The FC Bus shall also support peer-to-peer communications between non-supervisory devices, allowing these devices to communicate system data with each other directly, bypassing the supervisory network engine on the bus.
   iv. The FC Bus shall support a minimum of 100 equipment controllers and/or expansion modules in any combination.
   v. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the CVM and the furthest connected device.

t. The CVM shall include three (3) decimal rotary dial switches for setting the BACnet MS/TP device address.

u. The CVM shall have the ability to monitor and control a network of sensors and actuators over a SA Bus.
    i. The SA Bus shall be a MS/TP Bus supporting BACnet Standard Protocol SSPC-135.
    ii. The SA Bus shall support a minimum of 10 devices per trunk.
    iii. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the CVM/CVE and the furthest connected device.
v. The CVM shall have the capability to execute VAV box control sequences involving direct wired I/O points as well as input and output devices communicating over a MS/TP Bus.
w. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
x. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
y. The controller shall provide the ability to download and upload VAV box control application configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group.
z. Control setpoint changes initiated over the network shall be written to the controller's non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
aa. The CVM controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
bb. The CVM controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
cc. The CVM controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
dd. The CVM controller shall have on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The CVM shall calculate Exponentially Weighted Moving Averages (EWMA) for each of the following metrics, which shall be available to the end user for efficient management of the VAV terminals.
    i. Absolute temperature loop error
    ii. Signed temperature loop error
    iii. Absolute airflow loop error
    iv. Signed airflow loop error
    v. Average damper actuator duty cycle
ee. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
    i. Unreliable space temperature sensor
    ii. Unreliable differential pressure sensor
    iii. Starved box
    iv. Actuator stall
    v. Insufficient cooling
    vi. Insufficient heating
ff. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The CVM would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.

gg. The CVM controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality) and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.
hh. The CVM controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

3. XPM expansion I/O module
   a. The XPM provides additional input and output interfaces for use in digital controllers.
   b. The XPM shall communicate with controllers over the FC Bus or the SA Bus.
   c. The XPM shall support BACnet Standard ANSI/ASHRAE 135.
      i. The XPM shall be BTL listed/certified and carry the BTL Label.
      ii. The XPM shall be tested and certified as a BACnet Smart Actuator (B-SA).
      iii. A BACnet Protocol Implementation Conformance Statement shall be provided for the XPM.
      iv. The Conformance Statement shall be submitted 10 days prior to bidding.
   d. The XPM shall include pluggable screw terminal blocks for all I/O, SA/FC bus communication, and power wiring connections.
   e. The XPM shall include three (3) decimal rotary dial switches for setting the BACnet MS/TP device address.
   f. The XPM shall accommodate the direct wiring of analog and binary I/O field points with the following resolution:
      i. Inputs – 24-bit analog-to-digital converter
      ii. Outputs – +/- 200 mV accuracy in 0-10 VDC applications
   g. The XPM shall support the following types of inputs and outputs:
      i. Universal Inputs – shall be configured to monitor any of the following:
         - 0-10 VDC analog input
         - 4-20 mA analog input
         - 0-600k ohms analog input
         - Dry contact binary input
      ii. Binary Inputs – shall be configured to monitor either of the following:
         - Dry Contact Maintained Mode
         - Pulse Counter Mode
      iii. Analog Outputs – shall be configured to output either of the following:
         - 0-10 VDC analog output
         - 4-20 mA analog output
      iv. Binary Outputs – shall output the following:
         - 24 VAC Triac
      v. Configurable Outputs – shall be capable of the following:
         - 0-10 VDC analog output
         - 24 VAC Triac binary output
   h. The XPM shall include troubleshooting LEDs to indicate the following conditions:
      i. Power – to indicate if the device is powered or not powered
      ii. Fault – to indicate if the device is in its default state, has no faults, has a device fault, is in startup or download mode, or has an SA Bus communication issue
      iii. SA/FC Bus – to indicate if bus communication is occurring and normal, is not occurring, or was occurring but has been lost and is waiting to rejoin
      iv. EOL – to indicate if the end of line termination is on or off.

4. Network Thermostat

a. The network thermostat shall be capable of controlling two- or four-pipe fan coils, cabinet unit heaters, a pressure dependent VAV System, zoning type systems employing reheat including local hydronic reheat valves, or other similar equipment.
b. The Networked Thermostat shall communicate over the FC Bus using BACnet Standard protocol SSPC-135 or Johnson Controls N2 protocol.
    i. Communications shall be selectable locally at thermostat through the display.
c. The TEC shall be BTL listed/certified and carry the BTL Label.
    i. The TEC shall be tested and certified as a BACnet Advanced Application Controller (B-AAC).
    ii. A BACnet Protocol Implementation Conformance Statement shall be provided for the TEC.
    iii. The Conformance Statement shall be submitted 10 days prior to bidding.
d. The network thermostat shall include a 4.2 inch LED backlit touch screen with the following configurable icons.
    i. Home screen configurable icons include:
        - On/Off icon
        - Fan override icon
        - Zone temperature icon
        - Hold temperature icon
        - Zone humidity (on applicable models) icon
        - Occupancy status (on applicable models) icon
        - Temperature setpoint icon
        - Alarm icon
        - Unit status icon
        - Date/Time icon
        - Zone CO2 icon
    ii. Home screen non-configurable icon includes:
        - Menu icon
e. The network thermostat shall provide the flexibility to support any one of the following inputs:
    i. Integral indoor air temperature sensor.
    ii. Integral indoor occupancy sensor (PIR based)
    iii. Analog input for remote air temperature sensing that supports the following sensor types.
        - Nickel
        - Platinum
        - A99B PENN
        - 2.25k ohm NTC
        - 10k ohm NTC
        - 10k ohm NTC Type 3
    iv. Remote indoor air temperature sensor.
    v. Two configurable binary inputs with the following configurations:
        - Disabled
        - Occupancy
        - Override

- Remote PIR
- Dirty filter
- Service
- Fan Lock
- Open door
- Open window
- External interrupt

f. The network thermostat shall provide 4-digit passcode security.
g. The network thermostat shall employ nonvolatile EEPROM for all adjustable parameters.
h. The network thermostat shall have a temperature accuracy of ±0.9°F/±0.5°C at 70.0°F/21.0°C typical calibrated.
i. The network thermostat shall have a humidity accuracy of ±5% RH from 20 to 80% RH at 50 to 90°F (10 to 32°C.)
j. The network thermostat shall provide user equipment visibility from a mobile device through the MAP.
k. Where required by application and indicated on plans or room schedules provide the network thermostat with an integral Passive Infra-Red (PIR) occupancy sensor model.
l. On/off or floating fan coil and zoning applications:
    i. The network thermostat shall be capable of controlling two- or four-pipe fan coils, cabinet unit heaters, a pressure dependent VAV System, zoning type systems employing reheat including local hydronic reheat valves, or other similar equipment.
m. The network thermostat shall provide the flexibility to support any one of the following fan outputs:
    - Three speed fan control
    - Proportional speed fan control configurable from 0 to 10V
n. The network thermostat shall provide the flexibility to support any one of the following valve outputs:
    - Two on/off
    - Two floating
o. The network thermostat shall provide the flexibility to support High/Low voltage actuation with NO/NC configuration.
p. The network thermostat shall provide the flexibility to adjust the following control parameters:
    - Adjustable maximum setpoint offset from 0 to 20˚F
    - Adjustable fan on delay from 0 to 120 seconds
    - Adjustable fan off delay from 0 to 120 seconds
    - Adjustable minimum cooling on time from 0 to 360 seconds
    - Adjustable minimum cooling off time from 0 to 360 seconds
    - Adjustable minimum heating on time from 0 to 360 seconds
    - Adjustable minimum heating off time from 0 to 360 seconds
    - Adjustable minimum reheat on time from 0 to 360 seconds
    - Adjustable minimum reheat off time from 0 to 360 seconds
    - Adjustable stroke time from 5 to 300 seconds
    - Adjustable supply fan minimum command from 0 to 100%
    - Adjustable supply fan Medium command from 0 to 100%
    - Adjustable supply fan high command from 0 to 100%

- Adjustable reheat minimum damper position from 0 to 100%

2.6 SOFTWARE PROGRAMMING/TOOLS

A. Program Editor:

1. Existing programming tools shall be utilized for new controllers installed on this project.
2. Definition of operator device characteristics, DDC panels, individual points, applications, and control sequences shall be performed through fill-in-the-blank templates and a graphical programming approach.
3. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
4. The programming environment shall provide context-sensitive help menus and instructions for each operation and/or application currently being performed, for all programming functions, and for the programming language itself.
5. Selection of a single menu item or tool bar button shall print any displayed program on the system printer or to a text archive file. For source code orientated languages, formatted text printouts shall be provided. For graphical object orientated languages, program flow charts of objects shall be provided, and shall include links between objects and parameter values.
6. Libraries of standard application modules shall be provided, such as temperature, humidity, and static pressure control. These modules may be used as “building blocks” in defining or creating new control sequences. In addition, the user shall have the capability to easily create and archive new modules and control sequences, as desired, via a word processing type format or visual object configuration type format.
7. A library of standard forms designed to facilitate definition of point characteristics shall be provided. Forms shall be self-prompting and incorporate a fill-in-the-blank approach for definition of all parameters. The system shall immediately detect an improper entry, and automatically display an error message explaining the nature of the mistake.
8. A licensed software tool shall be provided that allows a user to simulate control sequence execution and test strategies before they are actually applied to mechanical systems. Users shall be able to enter hypothetical input data and verify desired control response and calculation results via graphical displays and hardcopy printouts.
9. The capability to backup and store all system databases on the workstation hard disk shall be provided. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations.
10. Database changes shall be recorded and downloaded to the appropriate controllers. The user shall also have the option to selectively download changes as desired.
11. A network, serial, or parallel port data connection shall be provided for the portable operator terminal to update its system database when specifically connected and activated by an operator.
12. A text-based programming language shall be provided to allow the user to define the licensed software configuration of DDC control logic for HVAC system control sequences, fan interlocks, pump interlocks, PID control loops, and other control relationships. The programming language shall conform to ANSI Basic. It shall be possible to edit and compile a program off-line, and upload or download the compiled program on-line.

2.7 INPUT DEVICES

A. General Requirements:

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors:

1. General Requirements:
   a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
   b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
   c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	+ .5°F
Room Temp	+ .5°F
Duct Temperature	+ .5°F.
All Others	+ .75°F.

2. Room Temperature Sensors:
   a. Room sensors shall be constructed for either surface or wallbox mounting.
   b. Room sensors shall have the following options when specified:
      1) Setpoint reset slide switch providing a +3 degree (adjustable) range.
      2) Individual heating/cooling setpoint slide switches.
      3) A momentary override request push button for activation of after-hours operation.
      4) Analog thermometer.
3. Room Temperature Sensors with Integral Display:
   a. Room sensors shall be constructed for either surface or wallbox mounting.
   b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
      1) Display room and outside air temperatures.
      2) Display and adjust room comfort setpoint.
      3) Display and adjust fan operation status.
      4) Timed override request push button with LED status for activation of after-hours operation.
      5) Display controller mode.
      6) Password selectable adjustment of setpoint and override modes.
4. Thermowells:
   a. When thermowells are required, the sensor and well shall be supplied as a complete assembly, including well head and Greenfield fitting.
   b. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.
   c. Thermowells and sensors shall be mounted in a threadolet or ½" NFT saddle and allow easy access to the sensor for repair or replacement.
   d. Thermowells shall be constructed of 316 stainless steel.
5. Outside Air Sensors:
   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
   b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
   c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
6. Duct Mount Sensors:

a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

7. Averaging Sensors:
   a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
   b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
   c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

C. Humidity Sensors:
1. The sensor shall be a solid state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. [more information]
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

D. Differential Pressure Transmitters:
1. General Air and Water Pressure Transmitter Requirements:
   a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
   b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
   c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the Test and Balance Agency and Owner permanent, easy-to-use connection.
   d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0” - 20” w.c.):
   a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following

performance specifications:

1) .01-20" w.c. input differential pressure range.
2) 4-20 mA output.
3) Maintain accuracy up to 20 to 1 ratio turndown.
4) Reference Accuracy: +0.2% of full span.

c. Medium to High Differential Water Pressure Applications (Over 21" w.c.):

1) The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
   a) Differential pressure range 10" w.c. to 300 PSI.
   b) Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).
2) Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

d. Building Differential Air Pressure Applications (-1" to +1" w.c.):

1) The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2) The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
   a) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
   b) 4-20 mA output.
   c) Maintain accuracy up to 20 to 1 ratio turndown.
   d) Reference Accuracy: +0.2% of full span.

E. Smoke Detectors:

1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 27 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 27, Fire Alarm System.

F. Status and Safety Switches:

1. General Requirements:
   a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the FMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
2. Current Sensing Switches:
   a. The current sensing switch shall be self-powered with solid state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
   b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
   c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
3. Air Filter Status Switches:

a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
c. Provide appropriate scale range and differential adjustment for intended service.

4. Air Flow Switches:
   a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
5. Air Pressure Safety Switches:
   a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
6. Low Temperature Limit Switches:
   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
7. High Limit Thermostats:
   a. High limit thermostats (firestats) shall be furnished and installed in the inlet air stream of each air moving device handling more than 600 CFM (with manual reset). Thermostats shall turn off the fans if the inlet temperature exceeds 125°F.

G. Water Meters - Chilled Water and Heating Water:
1. Water flow meters shall be a badger mag meter style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag. Flow meters shall be "insertion" type complete with "hot-tap" isolation valves to enable sensor removal without water supply system shutdown. Accuracy shall be ±2% of actual reading from 0.4 to 20 feet per second flow velocities.

H. Gas Meter:
1. The meter for the natural gas supply is to be a solid-state type suitable for commercial and industrial gas measurement applications, built upon an electronics platform that includes a solid-state thermal sensor, built-in temperature compensation and data logging capabilities. The flow measuring capability of the meter shall utilize fluidic oscillation technology (without moving parts). For operational safety, the meter cannot "lock-up" or stop gas flow upon malfunction of the electronics platform. The included battery for operating the electronics platform shall have a rated life expectancy of nine years (minimum). The body of the meter shall be a flanged faced wafer assembly, rated for 150 PSIG working pressure. The meter assembly shall be approved per UL 913 Class 1 Div. 1. The electronic output of the meter shall be equipped with four pulse output channels utilizing a provided 20 foot length output cable with mating binder connector. Gas meter shall Onicon or equal.

I. Domestic Water Flow Meter:

1. Domestic water flow meter shall be Elster Model C700, Badger or equal oscillating piston style positive displacement totalizing meter with bronze body construction; meter shall comply with AWWA C700 (latest revision), and shall be 2" size with 98.5 to 101.5% accuracy at 8 to 160 GPM flow rate. Meter shall include electronic register, Elster, Badger or equal. Install meter per manufacturer's requirements.

J. Outside Air Flow Control Modules:
1. Outside Air Flow Control Modules shall be capable of direct measurement of airflow through an outside air inlet and produce dual outputs; one representing the measured airflow, and the other to control the inlet damper.
2. Outside Air Flow Control Modules shall contain an integral multi-line liquid crystal display for use during the configuration and calibration processes. All configuration, output scaling, calibration, and controller tuning will be performed digitally in the on-board microprocessor via input pushbuttons.
3. Outside Air Flow Control Modules shall measure inlet airflow with an accuracy of ±5% of reading over a range of 150-600 FPM, 250-1,000 FPM, 150-2,000 FPM, and 500-2,000 FPM and not have its reading affected by the presence of directional or gusting wind. Measured airflow shall be density corrected for ambient temperature variances, and atmospheric pressure due to site altitude.
4. Outside Air Flow Control Modules shall interface with the building automation systems (BMCS), accepting inputs for fan system start and an external controller setpoint, and provide flow deviation alarm outputs.
5. The sensors shall be constructed of materials that resist corrosion due to the presence of salt or chemicals in the air; all non-painted surfaces shall be constructed of stainless steel. Sensors shall be factory mounted in an airflow station constructed of a 14 ga. galvanized steel, 6" deep welding casing with 90º connecting flanges and a galvanized expanded metal sheet. The electronics enclosure shall be NEMA 1
6. Outside Air Flow Control Modules shall be thermal dispersion type by Ebtron silver series.
7. The control dampers shall consist of a 16 ga galvanized steel channel frame with 5 in depth; airfoil shaped, galvanized steel double skin construction blades (14 ga equivalent thickness); blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper; 0.5 in dia. plated steel axles turning in synthetic (acetal) sleeve bearings; extruded silicone rubber blade seals for 300 F maximum temperature; 304 SS flexible jamb seals; and external (out of the airstream) blade-to-blade linkage.
8. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressures to 8 in wg, velocities to 4,000 ft/min and temperatures to 180 F. Testing and ratings to be in accordance with AMCA Standard 500.

2.8 OUTPUT DEVICES

A. Actuators:
1. General Requirements: Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
2. Electronic Damper Actuators:
   a. Electronic damper actuators shall be direct shaft mount.
   b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized based on actuator manufacturer’s recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical

spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.

c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

2. Electronic Valve Actuators:

a. Electronic valve actuators shall be manufactured by the valve manufacturer.

b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

B. Control Dampers:

1. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

2. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.

3. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 48". Damper blades shall be 16-gauge

minimum and shall not exceed six (6) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. Additional stiffening or bracing shall be provided for any section exceeding 48" in height. All damper bearings shall be made of stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x 48" size shall not leak in excess of 8.5 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.

4. Air foil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g.
5. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.
6. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jack shaft shall receive at least one actuator to reduce jack shaft twist.

C. Control Relays:
   1. Control Pilot Relays:
      a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
      b. Mounting bases shall be snap-mount.
      c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
      d. Contacts shall be rated for 10 amps at 120VAC.
      e. Relays shall have an integral indicator light and check button.

D. Control Valves:
   1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.
   2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves serving air handling unit coils shall be 2-way pattern, sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Where indicated on drawings for specified air handling units, control valves shall be 3-way pattern mixing type sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be 2-way pattern, sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
   3. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all hot and chilled water applications, except those described hereinafter. The valve discs shall be composition type. Valve stems shall be stainless steel.
   4. Ball valves shall be acceptable for water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units.
   5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or

three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

E. Local Control Panels:

1. All control panels shall be factory constructed, incorporating the FMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with sub-panel, hinged door, and key-locking latch.
2. In general, the control panels shall consist of the DDC controller(s), display module, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. The display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be extended to a numbered, color-coded, and labeled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.
4. All other wiring in the panel, internal and external, shall be made to additional line or low voltage color-coded and labeled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring for every control panel shall follow a common color-coded format. All terminal strip color coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

PART 3 – PERFORMANCE / EXECUTION

3.1 INSTALLATION PRACTICES

A. HVAC Control System Wiring:

1. All conduit, wiring, accessories and wiring connections required for the installation of the Facility Management System, as herein specified, shall be provided by the TCSI unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and national electric codes, unless otherwise specified in this section.
2. All system input wiring shall be twisted shielded pair, minimum 18 gauge wire. All system analog output wiring shall be twisted shielded pair/3-wire as required, minimum 18 gauge wire. Preconfigured cables between Terminal Unit Controllers and Thermostats are acceptable, minimum 24 gauge.
3. All internal panel device wiring for binary outputs and pilot relay shall be minimum 16 gauge wire.
4. All Class 2 wiring (24vac or less) wiring shall be installed in conduit unless otherwise specified.
   a. Class 2 wiring above concealed accessible locations shall be supported every 5' from the building structure utilizing j-hooks designed for this application.
5. Low voltage control wiring and 24VAC can be run in the same conduit.
6. All wiring in mechanical rooms and exposed locations shall be in conduit. Rough-ins for wall mounted thermostats shall have a back-box installed with conduit turned out above the ceiling. Minimum control wiring conduit size 1/2".

7. DDC System Multi-conductor Instrumentation and Communication Cabling:
   a. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC and General Purpose Cabling
      1) Cable shall consist of copper conductors not less No. 18 AWG-stranded.
      2) Shall be 2 or 3 conductor twisted cable with a drain wire
      3) Cable shall have a 100% overall shield.
      4) Cable shall be a plenum-rated.
      5) Cable shall meet or exceed NEC voltage rating of 300V.
      6) Cable shall be NEC type CMP.
      7) Cable shall meet or exceed UL temperature rating of +60 degrees C.
   b. Primary and Secondary Communications Network Cabling
      1) Cable shall be of type recommend by the DDC System Manufacturer.
      2) Cable shall be shielded.
      3) Cable shall be a plenum-rated.
      4) Cable shall meet or exceed NEC voltage rating of 150V.
      5) Cable shall meet or exceed UL temperature rating of +60 degrees C.
   c. Room Sensor Cabling
      1) Cable shall consist of copper conductors not less No. 24 AWG.
      2) Shall be multi-paired (at least two pairs) twisted cable.
      3) Cable shall have a 100% overall shield.
      4) Cable shall be a plenum-rated.
      5) Cable shall meet or exceed NEC voltage rating of 300V.
      6) Cable shall be NEC type Article 800-CMP.
      7) Cable shall meet or exceed UL temperature rating of +75 degrees C.

B. Identification and Naming Standards:
   1. Controller Identification. All controllers shall be identified according to standard name conventions. This contractor shall schedule a meeting prior to installation of controls to coordinate with Facility Services dept the equipment and tag names required to match this project. The naming scheme is to match with the equipment inventory system.
   2. Point Naming. All controllers shall be identified according to standard name conventions. This contractor shall schedule a meeting prior to installation of controls to coordinate with Facility Services Dept the point naming standards to match existing.
   3. Panel Identification. All local control panels shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure.
   4. Raceway Identification. All the covers to junction and pull boxes of the control system raceways shall be painted blue or have identification labels stating “Control System Wiring” affixed to the covers. Labels shall be typed, not hand written.
   5. Wire Identification. All low and line voltage control wiring shall be identified by a number, as referenced to the associated control diagram, at each end of the conductor or cable. Identification number shall be permanently secured to the conductor or cable and shall be typed. All control wiring shall be identified by appropriate label (analog input, analog output, binary input, binary output,) every five feet.

C. Digital Controller Systems:
   1. Each system will be provided with its own dedicated direct digital controller or application specific controller. Mechanical systems such as AHUs, VAVs or Packaged system shall not be controlled from more than 1 application specific controller.
   2. Systems that use second tier controllers as point expansion for system controllers shall only be allowed under when the I/O points are directly controlled by the CPU of the local application specific controller.

D. Input Devices:

1. All Input devices shall be installed per the manufacturers recommendation. All in-line devices such as temperature wells, pressure taps, duct smoke detectors, air flow stations, etc. bleed units and control valves are to be mounted (to the appropriate mechanical piping/duct systems) by the installer of the mechanical piping/duct system, as applicable.

E. Output Devices:
1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
3. Control Dampers: Shall be opposed blade for modulating control of air flows. Parallel blade dampers shall be installed for two position applications.
4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.

3.2 COMMISSIONING

A. Commissioning the Facility Management System is a mandatory documented performance requirement of the selected TCSI for all control systems detailed in this Specification and sequence of operations. Commissioning shall include verification of proper installation practices by the TCSI and subordinate installers, point verification and calibration, system/sequence of operation verification with respect to specified operation, and network/workstation verification. Documentation shall be presented upon completion of each commissioning step and final completion to ensure proper operation of the Facility Management System.

B. Acceptance Check List: An acceptance checklist shall be completed that documents compliance with each item of this Specification.

C. Testing Procedure: Upon completion of the installation, the TCSI shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. The TCSI shall be responsible for generating all software and entering all database information necessary to perform the sequences of control herein specified.

D. Testing Documentation: Prior to acceptance testing, TCSI shall create, on an individual system basis, trend logs of input and output points, or have an automatic Point History feature for documentation purposes.

E. Field Points Testing:
1. This step shall verify that all of the installed points receive or transmit the correct information prior to loading/activating the system software.
2. ON/OFF commands from the workstation shall be performed in order to verify each binary output point.
3. All binary input points are to be tested using the HAND/OFF/AUTOMATIC selector switch on the associated motor control center or by manually jumpering across the field device contacts.
4. All analog output points providing pneumatic output control shall be tested using a command from the workstation to modulate the output from minimum calibrated signal to maximum calibrated signal. Analog Output values to Pneumatic transducers shall be displayed so that a 0 percent display value corresponds to the pressure required to set the pneumatic actuator to minimum position, and a 100 percent display value corresponds to the pressure required to set the pneumatic actuator to the maximum position.

5. All analog output points shall be tested using a command from the workstation to modulate the output device from minimum calibrated signal to maximum calibrated output.
6. All analog input points are to be tested by comparing the reading obtained through the workstations or portable terminal to the value of an independent testing meter.

F. VAV box performance verification and documentation:
1. As part of the commissioning of the terminal unit control and air distribution system, the Installer shall initiate an automated test where the dampers in one half of a group of boxes are stepped towards full open while the other half are stepped towards full closed. At each step, after a settling time, box airflows and damper positions will be sampled. Following the cycle, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation, or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
2. The TCSI shall issue a report based on a sampling of the CVM calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance. The sampling shall take place after completion of Test and Balance, when design cooling and heating media have been available and occupied conditions approximated for five consecutive days.

G. Noncompliant Items:
1. The Installer shall remove and replace, at its expense, all items that are not in compliance with the Specification requirements.

3.3 SYSTEM FMS SPECIFIC REQUIREMENTS

A. FMS Remote Access:
1. The Facility Management System provided shall include the capability for multiple users to access the FMS simultaneously from remote locations. Interface shall be to the entire FMS and provide the capability to monitor all I/O and adjust parameters.

3.4 ALARM MANAGEMENT

A. Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC panel shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, to minimize network traffic, and to prevent alarms from being lost. At no time shall the DDC panel's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device, or communications with other panels on the network.

B. Point Change Report Description:
1. All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

C. Prioritization:
1. The installer shall set up all system analog points with high and low alarm limits. All digital system points shall be associated with a status feedback point and all exceptions shall be reported as alarms. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized and filtered to minimize nuisance reporting and to speed operator response to critical alarms.
2. The user shall also be able to define under which conditions point changes need to be

acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.

D. Critical and Non-Critical Alarm Routing:
1. Critical alarms shall be defined as chiller, boiler, generator, critical space temperature or humidity, and kilowatt demand approaching threshold. Critical alarms shall be displayed at the workstation and an email will be sent to the list of users. The alarms will have the ability to be set by priority for escalation.
2. All other alarms shall be considered non-critical and shall be displayed and acknowledged before being sent to the alarm log.

E. Report Routing:
1. Alarm reports, messages, and files will be directed to a user-defined list of operator devices, or PCS used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.

F. Alarm Messages:
1. In addition to the point's descriptor and the time and date, the user shall be able to print, display, or store a 65-character alarm message to more fully describe the alarm condition or direct operator response.
2. Each standalone DDC panel shall be capable of storing a library of at least 250 Alarm Messages. Each message may be assignable to any number of points in the panel.

G. Auto-Dial Alarm Management:
1. In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request is made, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

3.5 DYNAMIC ANIMATED COLOR GRAPHIC DISPLAYS

A. TCSI shall update and utilize the existing floor-plan graphics licensed software to include the new equipment and control points required for this project.

B. Color graphic floor plan displays, and system schematics for each piece of mechanical equipment (including air handling units, variable air volume boxes, fan coils, unit ventilators, cabinet heaters, exhaust fans, fin tube radiation, chilled water systems, hot water boiler systems, and so forth as required) shall be provided, as specified in the point list portion of this Specification, in order to optimize system performance analysis, speed alarm recognition, and simplify user interaction. The TCSI shall fully configure the color graphics and plot all associated control/monitoring points on the screen. Copies of all color graphics screens shall be provided as color printouts to the engineer for approval.

C. System Selection/Penetration:
1. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, or test-based commands. Floor plans shall display room numbers and each zone shall be color-coded. The operator shall be able to point and click on a room or zone of rooms (in the case of an air handler that serves more than one zone). The room or zone will display an animated flow diagram of the mechanical equipment that serves that zone, with all control and monitoring points associated with that piece of equipment, including setpoints. Setpoints shall be overridden or modified from this screen.

D. Dynamic Animated Data Displays:
   1. Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention. Damper and valve positions, air and water flow shall be animated and shall represent actual, current conditions.

E. Windowing:
   1. The windowing environment of the PC Operator Workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

F. Alarm Annunciation:
   1. Any point in a state of alarm shall change the color of its symbol to red until it is no longer in alarm.

3.6 WARRANTY RESPONSE/TRAINING

A. Response to all warranty request shall be made by the TCSI. TCSI shall warrant labor and material for one year from date of acceptance. TCSI shall verify proper operation of the DDC controls system and identify items requiring repair and/or replacement. TCSI shall repair and/or replace any and all FMS items.

B. Provide (2) four hour training sessions on the system.

3.7 SYSTEM COMPLETION

A. Upon completion of installation, TCSI shall start up the system shall start up the system and perform all necessary testing and run diagnostics to ensure proper operation. An acceptance test shall with a owners representative and the engineer shall be performed at the completion of the project. The test shall consist of a point to point checkout to ensure proper operation of all systems components, sequence of operations, verify graphics and verify proper naming conventions per standards. Provide a checklist with each point verified by the control contractors prior to the acceptance test. When the system performance is deemed 100% complete by the engineer and owners rep, the system will be accepted.

PART 4 - SEQUENCE OF OPERATIONS

CHILLED WATER SYSTEM/CONDENSER WATER - SEQUENCE OF OPERATION

SYSTEM ENABLE:
The cooling system will automatically start when the system enable (SYSTEM-EN) is "ON". When the system enable is "OFF", the cooling system will be disabled.

CHILLER CONTROL:
This system consists of three chillers. The chillers shall be controlled via their own internal controls to maintain a chilled water supply temperature. Each chiller (CHx-EN) will be staged on and off in order to meet the chiller load as measured by the percent of full load amps (CHx-%FLA). The chiller isolation valves (CHxCHWISO-C & CHxCWISO-C) will be commanded open prior to starting the pump and kept open long enough for the pump to coast down. If the status (CHxCHWISO-S) of the chiller isolation valve fails to match the command (CHxCHWISO-C), an alarm will be generated and the next chiller in sequence will be enabled.

CHILLED WATER PUMP CONTROL:
When enabled, a pump (PCHWPx-C) for each chiller will be started. After the chiller is commanded off, the pump (PCHWPx-C) will continue to run for a short time to allow the equipment to coast down. If the pump status (PCHWPx-S) does not match the command (PCHWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (PCHWPx-S), the pump (PCHWPx-C) will restart after the system reset (SYS-RESET) is activated. Each pump has a variable frequency drive (PCHWPx-O) that will modulate in unison to maintain differential pressure setpoint (CHWDP-SP) as sensed by the primary loop pressure sensor (CHW-DP). A bypass valve (CHWBYPV-O) will be modulated to maintain primary flow sensor (PCHW-F) to calculated chiller minimum flow setpoint based on the number of chillers running.

CONDENSER WATER PUMP CONTROL:
When enabled, a pump (CWPx-C) for each chiller will be started. If the pump status (CWPx-S) does not match the command (CWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (CWPx-S), the pump (CWPx-C) will restart after the system reset (SYS-RESET) is activated. After the chiller is commanded off, the pump (CWPx-C) will continue to run for a short time to dissipate the heat.

CONDENSER WATER SYSTEM:
This system consists of three variable speed (CTx-C, CTx-O) cooling towers. The system also has a tower water bypass valve (CTV-O) that shall modulate to full water flow over the towers, then the cooling towers will be staged (CTx-C) on and off to maintain a condenser supply water temperature setpoint (CW-SP). When an additional cooling tower (CTx-C) is required, the tower (CTx-C) with the lowest runtime total shall be enabled to run. If the tower fan status (CTx-S) does not match the command (CTx-C), an alarm will be generated and the tower fan will be stopped. Upon loss of status (CTx-S), the tower fan (CTx-C) will restart after the system reset (SYS-RESET) is activated. The tower isolation valve (CTxISO-C) will be commanded open prior to starting the pump and kept open long enough for the pump to coast down. If the status (CTxISO-S) of the tower isolation valve fails to match the command (CTxISO-C), an alarm will be generated and the next tower in sequence will be enabled.

HEATING HOT WATER SYSTEM - SEQUENCE OF OPERATION

SYSTEM ENABLE:
The heating system will automatically start when the outside air temperature (OA-T) falls below the system enable setpoint (HTGOATLOCKOUT-SP) while the system enable (SYSTEM-EN) is "ON". When the outside air temperature (OA-T) rises above this setpoint (HTGOATLOCKOUT-SP) or the system enable (SYSTEM-EN) is "OFF", the heating system will be disabled.

SYSTEM SHUTDOWN:
When the emergency shutdown switch (EMER-STOP) is activated, the heating system will be shutdown. A gas shutoff valve will be provided on the incoming gas main to the central plant. If the emergency shutdown switch is activated, the gas shutoff valve will close.

BOILER CONTROL:
This system consists of three boilers (BLRx-EN). The burners shall be controlled via their own internal controls. The outdoor air temperature (OA-T) shall determine the number of boilers running. When an additional boiler is required, the boiler with the lowest runtime total shall be enabled to run. The boiler isolation valve (BLRxISO-C) will be commanded open prior to starting the pump and kept open long enough for the pump to coast down. If the status (BLRxISO-S) of the boiler isolation valve fails to match the command (BLRxISO-C), an alarm will be generated and the next boiler in sequence will be enabled.

HOT WATER PUMP CONTROL:
When enabled, pumps (PHWPx-C) will be started so that minimum flow is maintained to the boilers that are running. After the boiler is commanded off, the pump (PHWPx-C) will continue to run for a short time to dissipate the heat. If the pump status (PHWPx-S) does not match the command (PHWPx-C), an alarm will be generated and the pump will be stopped. Upon loss of status (PHWPx-S), the pump (PHWPx-C) will restart after the system reset (SYS-RESET) is manually activated.

PRIMARY LOOP PRESSURE CONTROL:
When a pump status (PHWPx-S) is verified, the pump will modulate (PHWPx-O) to maintain the system differential pressure (HW-DP) of the system. If the primary flow (PHW-F) below the minimum flow setpoint the system bypass valve (BYPV-O) will modulate open to provide more flow thru the boilers.

ADDITIONAL POINTS MONITORED BY THE BAS:
- Boiler n Status (BLRn-S)
- Boiler n Alarm (BLRn-A)
- Boiler n Leaving Water Temperature (BLRnLW-T)
- Loop Differential Pressure Sensor (HW-DP)
- Primary HW Supply Temperature (PHWS-T)
- Primary HW Return Temperature (PHWR-T)

COOLING ONLY VAV AHU – SEQUENCE OF OPERATION

SUPPLY FAN CONTROL:
The variable speed supply fan (SF-C) will be started based on occupancy schedule (OCC-SCHEDULE). When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. The supply fan (SF-O) will modulate to maintain the discharge static pressure (DA-P) at setpoint (DAP-SP). Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. If positive status is not received after 5 minutes (adjustable), an alarm shall be generated on the BAS.

ECONOMIZER CONTROL:
When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.

OA CONTROL:
The outdoor air damper will modulate to maintain the outdoor airflow (OA-F) via a thermal dispersion airflow measuring station located in the outdoor air duct.

MINIMUM OA CONTROL:
The fresh air intake of the unit will be limited to prevent the mixed air temperature (MA-T) from falling below the low limit setpoint (OALT-SP).

COOLING COIL:
The chilled water valve (CLG-O) will modulate to maintain the temperature setpoint of 55 degrees off the leaving side of the chilled water coil. When the condensate float switch is in "Alarm" (COND-A), the cooling control sequence will be disabled and an alarm will be generated on the BAS.

DEHUMIDIFICATION:
On a rise in the return air humidity (RA-H), the chilled water valve will be overridden to 100% to maintain the return air humidity below the return air dehumidification setpoint (DEHUM-SP) of 60% relative humidity. The reheat control at the VAV boxes will maintain the temperature at space setpoint.

UNIT PROTECTION:

- Low Temperature Alarm (LT-A) - When in "Alarm", the control sequence will stop running, the valve(s) will open and the fan(s) will be disabled via a hard wired shutdown circuit.
- Discharge Air Smoke Detector (DA-SD) - Disables the fan(s) via a hard wired shutdown circuit.
- Return Air Smoke Detector (RA-SD) - Disables the fan(s) via a hard wired shutdown circuit.

ADDITIONAL POINTS MONITORED BY THE BAS:

- Supply Fan Output Frequency (SF-HZ)
- Return Air Temperature (RA-T)
- Prefilter Diff Pressure (PFILT-DP)
- Discharge Air Smoke Alarm (DA-SD)
- Return Air Smoke Alarm (RA-SD)
- Outdoor Air Damper Position (OAD-POS)
- Return Air Damper Position (RAD-POS)
- Cooling Position (CLG-POS)

CHW VAV AHU W/PREHEAT - SEQUENCE OF OPERATION

SUPPLY FAN CONTROL:

The variable speed supply fan (SF-C) will be started based on occupancy schedule (OCC-SCHEDULE). When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. The supply fan (SF-O) will modulate to maintain the discharge static pressure (DA-P) at setpoint (DAP-SP). Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. If positive status is not received after 5 minutes (adjustable), an alarm shall be generated on the BAS.

ECONOMIZER CONTROL:

When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.

OA CONTROL:

The outdoor air damper will modulate to maintain the outdoor airflow (OA-F) via a thermal dispersion airflow measuring station located in the outdoor air duct.

MINIMUM OA CONTROL:

The fresh air intake of the unit will be limited to prevent the mixed air temperature (MA-T) from falling below the low limit setpoint (OALT-SP).

PREHEAT COIL:

The preheat control valve (PH-O) will modulate to maintain the temperature setpoint of 55 degrees on the leaving side of the preheat coil. When the unit is shutdown, the preheat control valve will fully close. The preheat coil will be locked out on a rise in outdoor air temperature (OA-T) above the lockout setpoint (HTGOATLOCKOUT-SP) of 50 degrees. Upon a loss of airflow (SF-S), the preheat control valve will fully close. If the preheat temperature falls below 40 degrees for 5 minutes, an alarm shall be generated on the BAS.

COOLING COIL:

The chilled water valve (CLG-O) will modulate to maintain the temperature setpoint of 55 degrees off the leaving side of the chilled water coil. When the unit is shutdown, the chilled water valve will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

Upon a loss of airflow (SF-S), the chilled water valve will fully close. When the condensate float switch is in "Alarm" (COND-A), the cooling control sequence will be disabled and an alarm will be generated on the BAS.

DEHUMIDIFICATION:
On a rise in the return air humidity (RA-H), the chilled water valve will be overridden to 100% to maintain the return air humidity below the return air dehumidification setpoint (DEHUM-SP) of 60% relative humidity. The reheat control at the VAV boxes will maintain the temperature at space setpoint.

UNIT PROTECTION:
- Low Temperature Alarm (LT-A) - When in "Alarm", the control sequence will stop running, the valve(s) will open and the fan(s) will be disabled via a hard wired shutdown circuit.
- Discharge Air Smoke Detector (DA-SD) - Disables the fan(s) via a hard wired shutdown circuit.
- Return Air Smoke Detector (RA-SD) - Disables the fan(s) via a hard wired shutdown circuit.

ADDITIONAL POINTS MONITORED BY THE BAS:
- Supply Fan Output Frequency (SF-HZ)
- Return Air Temperature (RA-T)
- Prefilter Diff Pressure (PFILT-DP)
- Discharge Air Smoke Alarm (DA-SD)
- Return Air Smoke Alarm (RA-SD)
- Outdoor Air Damper Position (OAD-POS)
- Return Air Damper Position (RAD-POS)
- Cooling Position (CLG-POS)
- Preheat Position (PH-POS)

CHW VAV AHU W/REHEAT - SEQUENCE OF OPERATION

SUPPLY FAN CONTROL:
The variable speed supply fan (SF-C) will be started based on occupancy schedule (OCC-SCHEDULE). When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. The supply fan (SF-O) will modulate to maintain the discharge static pressure (DA-P) at setpoint (DAP-SP). Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. If positive status is not received after 5 minutes (adjustable), an alarm shall be generated on the BAS.

ECONOMIZER CONTROL:
When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.

OA CONTROL:
The outdoor air damper will modulate to maintain the outdoor airflow (OA-F) via a thermal dispersion airflow measuring station located in the outdoor air duct.

MINIMUM OA CONTROL:
The fresh air intake of the unit will be limited to prevent the mixed air temperature (MA-T) from falling below the low limit setpoint (OALT-SP). If the mixed air temperature falls below 40 degrees for 5 minutes, an alarm shall be generated on the BAS.

COOLING COIL:
The chilled water valve (CLG-O) will modulate to maintain the temperature setpoint of 55 degrees off the leaving side of the chilled water coil. When the unit is shutdown, the chilled water valve will be commanded to a preset

position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the chilled water valve will fully close. When the condensate float switch is in "Alarm" (COND-A), the cooling control sequence will be disabled and an alarm will be generated on the BAS.

REHEAT COIL:
The reheat control valve (RH-O) will modulate to maintain the space temperature setpoint sensed by the zone sensor. When the unit is shutdown, the reheat control valve will fully close. Upon a loss of airflow (SF-S), the reheat coil will remain in control.

DEHUMIDIFICATION:
On a rise in the return air humidity (RA-H), the chilled water valve will be overridden to 100% to maintain the return air humidity below the return air dehumidification setpoint (DEHUM-SP) of 60% relative humidity. The reheat control at the VAV boxes will maintain the temperature at space setpoint.

UNIT PROTECTION:
- Low Temperature Alarm (LT-A) - When in "Alarm", the control sequence will stop running, the valve(s) will open and the fan(s) will be disabled via a hard wired shutdown circuit.
- Discharge Air Smoke Detector (DA-SD) - Disables the fan(s) via a hard wired shutdown circuit.
- Return Air Smoke Detector (RA-SD) - Disables the fan(s) via a hard wired shutdown circuit.

ADDITIONAL POINTS MONITORED BY THE BAS:
- Supply Fan Output Frequency (SF-HZ)
- Return Air Temperature (RA-T)
- Prefilter Diff Pressure (PFILT-DP)
- Discharge Air Smoke Alarm (DA-SD)
- Return Air Smoke Alarm (RA-SD)
- Outdoor Air Damper Position (OAD-POS)
- Return Air Damper Position (RAD-POS)
- Cooling Position (CLG-POS)
- Reheat Position (RH-POS)

VAV BOX - SEQUENCE OF OPERATION

OCCUPIED MODE:
When the zone temperature (ZN-T) is between the occupied heating (EFFHTG-SP) and cooling (EFFCLG-SP) setpoints, the primary air damper (DPR-O) will be at the minimum CFM (SA-F) and there will be no mechanical heating. On a rise in zone temperature (ZN-T) above the cooling setpoint (EFFCLG-SP), the primary air damper (DPR-O) will increase the CFM (SA-F) and there will be no mechanical heating. On a drop in zone temperature (ZN-T) below the heating setpoint (EFFHTG-SP), the heating water control valve will modulate to maintain the zone temperature (ZN-T) and the damper (DPR-O) is controlled to provide a minimum CFM (SA-F).

UNOCCUPIED MODE:
When in this mode, while the zone temperature (ZN-T) is between the unoccupied heating (EFFHTG-SP) and cooling (EFFCLG-SP) setpoints, the primary air damper (DPR-O) will be at the minimum CFM (SA-F) and there will be no mechanical heating. On a rise in zone temperature (ZN-T) above the unoccupied cooling setpoint (EFFCLG-SP), the primary air damper (DPR-O) will increase the CFM (SA-F) (if available) and there will be no mechanical heating. On a drop in zone temperature (ZN-T) below the unoccupied heating setpoint (EFFHTG-SP), the heating water control valve will modulate to maintain the zone temperature (ZN-T) and the primary air damper (DPR-O) will be at the minimum CFM (SA-F).

DISCHARGE AIR TEMP SENSOR:
A discharge air temp (DA-T) sensor is provided on each box for monitoring purposes.

UNIT ENABLE:
A network unit enable (UNITEN-MODE) signal will control the mode of the box.

NETWORK WARMUP-COOLDOWN:
Warm-up and Cooldown modes will be activated by a network command (WC-C). When the zone temperature (ZN-T) is below the effective heating setpoint (EFFHTG-SP), the box damper will be modulated to allow warm air flow, then reheat coil to maintain the zone temperature (ZN-T). When the box effective heating setpoint is satisfied the flow will remain at the warm-up minimum position until the warm command has been removed.

FAN COIL UNIT - SEQUENCE OF OPERATION

SUPPLY FAN CONTROL:
When the thermostat fan mode is set to on, the supply fan will run continuously. When the thermostat fan mode is set to auto, the supply fan will run anytime there is a call for heating or cooling. The air proof switch will shut down control if no airflow is detected.

TEMPERATURE CONTROL:
The unit will control to maintain the zone temperature setpoint as sensed by the zone temperature sensor.

HUMIDITY CONTROL:
When the zone humidity exceeds the humidity setpoint, the cooling output will be overridden to provide dehumidification. The heating coil will be utilized as required to maintain zone temperature. Dehumidification does not operate when heating. And stops if the zone temperature drops below heating setpoint. While in the dehumidification mode, the fan runs at it lowest possible speed.

OCCUPIED MODE:
The occupancy mode will be controlled via a network input.

COOLING COIL:
The cooling coil will be modulated to maintain the temperature setpoint.

HEATING COIL:
The heating coil will be modulated to maintain the temperature setpoint.

ADDITIONAL POINTS MONITORED BY THE BAS:
- Supply Fan Status (SF-S)
- Discharge Air Temperature (DA-T)

Pool/Pool Equipment and General Exhaust Fans (EF-1 thru 12 and EF-16 thru 19) - Sequence of Operation
The exhaust fan will run continuously. The building automation system shall start/stop and monitor the exhaust fan via a current sensing relay. An alarm will be generated upon loss of status.

Refrigerant Purge Exhaust Fan (EF-13) - Sequence of Operation
Ceiling mounted exhaust fan will be enabled by the refrigerant monitor upon detection of refrigerant. A strobe shall be mounted above each doorway entering the chiller room and shall be on whenever the refrigerant monitor

is in alarm. The building automation system shall monitor the status of the refrigerant monitor trouble/alarm contacts and the exhaust fan. An alarm will be generated if the refrigerant monitor is in alarm but the exhaust fan status is off.

Dishwasher Exhaust Fan (EF-14) - Sequence of Operation

The exhaust fan shall be interlocked to run when the dishwasher is on. The building automation system shall monitor the exhaust fan via a current switch.

MRI Room Exhaust Fan (EF-15) - Sequence of Operation

An oxygen (O2) monitor will be installed to sense the oxygen level in the MRI room. The exhaust fan shall be enabled when the O2 monitor goes into alarm at 19.5% (field adjustable). An emergency pushbutton shall be provided in the space to override the exhaust fan to enable. A strobe shall be mounted above each doorway entering the MRI room and shall be on whenever the O2 monitor is in alarm. The building automation system shall monitor the status of the O2 monitor's alarm contact and the exhaust fan. An alarm will be generated if the O2 monitor is in alarm but the exhaust fan status is off.

HEATING HOT WATER TO DOMESTIC HOT WATER HEAT EXCHANGER (HEX-1) - SEQUENCE OF OPERATION

The heat exchanger recirculating pump will run continuously. The BAS will start/stop and monitor the recirculating pump via a current sensing relay. A modulating control valve on the heating hot water return will modulate to maintain 140 degree LWT on the domestic hot water supply. A temperature sensor will be installed in the supply and return heating hot water lines. A temperature sensor will be installed in the return domestic hot water line. A flow meter will be installed in the supply line of the heating hot water. A flow calculation shall be programmed in the BAS to show BTU usage on the heating hot water side of the heat exchanger.

PART 5- POINTS LIST

CHILLED WATER/CONDENSER WATER SYSTEM

DO CHILLER START/STOP (PER CHILLER)
DO CHW PUMP START/STOP (PER PUMP)
DO CW PUMP START/STOP (PER PUMP)
DO COOLING TOWER FAN START/STOP (PER TOWER FAN)
DO CHILLER CHW ISOLATION VALVE (PER CHILLER)
DO CHILLER CW ISOLATION VALVE (PER CHILLER)
DO COOLING TOWER ISOLATION VALVE (PER TOWER)
DI CHILLER STATUS (PER CHILLER)
DI CHW PUMP STATUS (PER PUMP)
DI CW PUMP STATUS (PER PUMP)
DI COOLING TOWER FAN STATUS (PER TOWER FAN)
DI COOLING TOWER VIBRATION ALARM (PER TOWER)
DI CHILLER CHW ISOLATION VALVE OPEN STATUS (PER CHILLER)
DI CHILLER CW ISOLATION VALVE OPEN STATUS (PER CHILLER)
AO CHILLED WATER MINIMUM BYPASS VALVE
AO CONDENSER WATER BYPASS VALVE
AO CHILLED WATER PUMP SPEED (PER PUMP)
AO CONDENSER WATER PUMP SPEED (PER PUMP)
AO COOLING TOWER FAN SPEED (PER TOWER)
AI PRIMARY CHILLED WATER FLOW
AI PRIMARY CONDENSER WATER FLOW

AI CHILLED WATER LOOP SUPPLY WATER TEMP
AI CHILLED WATER LOOP RETURN WATER TEMP
AI CONDENSER WATER LOOP SUPPLY WATER TEMP
AI CONDENSER WATER LOOP RETURN WATER TEMP
AI CHILLER CHW ENTERING WATER TEMP (PER CHILLER)
AI CHILLER CHW LEAVING WATER TEMP (PER CHILLER)
AI CHILLER CW ENTERING WATER TEMP (PER CHILLER)
AI CHILLER CW LEAVING WATER TEMP (PER CHILLER)
AI CHILLED WATER LOOP DP TRANSMITTER
AI OUTSIDE AIR TEMP
AI OUTSIDE AIR HUMIDITY
REFRIGERANT ALARM MONITORING
BACNET INTEGRATION TO CHILLERS, CHW PUMP VFDs, CW PUMP VFDs and COOLING TOWER VFDs

HEATING HOT WATER SYSTEM

DO BOILER START/STOP (PER BOILER)
DO HOT WATER PUMP START/STOP (PER PUMP)
DI BOILER STATUS
DI BOILER ALARM (PER BOILER)
DI BOILER ISOLATION VALVE OPEN STATUS (PER BOILER)
DI HOT WATER PUMP STATUS (PER PUMP)
DI EMERGENCY STOP
AO HOT WATER PUMP SPEED (PER PUMP)
AO HOT WATER LOOP BYPASS VALVE
AI HOT WATER LOOP DP TRANSMITTER
AI PRIMARY HOT WATER LOOP FLOW METER
AI HOT WATER LOOP SUPPLY WATER TEMP
AI HOT WATER LOOP RETURN WATER TEMP
AI BOILER LEAVING WATER TEMP (PER BOILER)
BACNET INTEGRATION TO BOILERS and HW PUMP VFDs

VAV AIR HANDLING UNITS

DO FAN START/STOP
DI FAN STATUS
DI CONDENSATE ALARM
DI LOW LIMIT TEMP ALARM
AI STATIC PRESSURE
AI MIXED AIR TEMP
AI RETURN AIR TEMP
AI DISCHARGE AIR TEMP
AI RETURN AIR HUMIDITY
AI PREFILTER STATUS
AI OUTSIDE AIRFLOW MEASURING STATION
AI RETURN AIR DAMPER POSITION
AI OUTDOOR AIR DAMPER POSITION
AI SUPPLY FAN SPEED FEEDBACK
AI CHILLED WATER VALVE POSITION
AI PREHEAT WATER VALVE POSITION (AHU-3 ONLY)
AI REHEAT WATER VALVE POSITION (AHU-1, 4 & 8 ONLY)
AO CHILLED WATER VALVE
AO PREHEAT WATER VALVE (AHU-3 ONLY)
AO REHEAT WATER VALVE (AHU-1, 4 & 8 ONLY)
AO OUTSIDE AIR DAMPER

AO RETURN AIR DAMPER
AO SUPPLY FAN VFD SPEED

VAV BOXES:
AI SUPPLY AIR CFM
AI DISCHARGE AIR TEMP
AI SPACE TEMP
AI SPACE TEMP SETPOINT
AO HOT WATER VALVE (WHERE APPLICABLE)
AO DAMPER

FAN COIL UNITS
DO FAN START/STOP
DI FAN STATUS
AI ZONE TEMP
AI ZONE HUMIDITY
AI DISCHARGE AIR TEMP
AO CHILLED WATER VALVE
AO HOT WATER VALVE

EF-1 – 12 AND 16 - 19
- DI FAN STATUS
- DO FAN START/STOP

EF-13
- DI FAN STATUS
- DI REFRIGERANT MONITOR ALARM
- DI REFRIGERANT MONITOR TROUBLE

EF-14
- DI FAN STATUS

EF-15
- DI FAN STATUS
- DI O2 ALARM
- DO FAN START/STOP
- AI O2 LEVEL

HEX-1
- DI RECIRC PUMP STATUS
- DO RECIRC PUMP START/STOP
- AI HEATING HOT WATER SUPPLY TEMP
- AI HEATING HOT WATER RETURN TEMP
- AI DOMESTIC HOT WATER SUPPLY TEMP
- AI DOMESTIC HOT WATER RETURN TEMP
- AI HEATING HOT WATER FLOW
- AO HEATING HOT WATER CONTROL VALVE

MISCELLANEOUS
- DI SUMP PUMP STATUS
- DI HEAT TRACE STATUS

- BACnet INTEGRATION TO MULTIZONE MINISPLIT SYSTEMS
- BACnet INTEGRATION TO DOMESTIC BOOSTER PUMP SKID
- BACnet INTEGRATION TO GENERATOR

END OF SECTION 23 09 00

SECTION 23 09 05 - AUTOMATIC TEMPERATURE CONTROLS – COMMISSIONING

PART 1 - GENERAL

1.1 COMMISSIONING AND QUALITY ASSURANCE

A. Quality Assurance. Quality assurance for automatic controls systems shall be accomplished through the commissioning process consisting of submittal review of system engineering work, documented pre-functional testing and initial checkout, documented functional performance testing, operator training and O&M documentation. In addition there will be a qualification procedure for the manufacturer and lead installation technician.

B. Related Sections. The general commissioning process procedures and requirements are given in Section 01 91 13 with responsibilities unique to Division 23 included in Section 23 08 10, including O&M manual documentation and training requirements. The common process requirements for initial system checkout are found in Section 23 08 12. Specific functional testing requirements are identified in Section 23 08 11.

1.2 QUALIFICATION OF MANUFACTURER AND LEAD INSTALLING TECHNICIAN

A. Manufacturer and Vendor. Within 14 days after notice to proceed, the controls contractor shall submit to the GC, CM and PM a certified statement, signed by an officer of the manufacturer and vendor which includes the following: name and address of company; name, address and telephone number of the local representative; a general sales bulletin covering the full line of products manufactured; a certification that the products proposed for this contract have been in continuous and successful use for at least 1 year, not including beta testing, and general information covering the functions and characteristics of the systems proposed. In addition, provide a list of four projects which the vendor has installed that are similar in size and complexity to this contract, with the name and telephone number of the contracting officer and facility administrator, size of project, location and brief description and date of completion.

B. Lead Programmer (LP). The majority of the programming for this project will be completed by the lead programmer. The LP will personally review and approve all programming by others. Within 14 days after notice to proceed, the controls contractor shall submit the following regarding the LP: name; address; telephone number; certification of training on this system; list of two projects of similar size and complexity to this contract which were primarily programmed by the LP; and for each project the project name, location, description, cost, name and telephone number of the contracting officer and current facility administrator and date of completion. A replacement to the LP must be approved in writing by the Owner.

C. Lead Installation Technician (LIT). The automatic controls will be installed under the direct and continuous supervision of a lead technician authorized by the manufacturer. Within 14 days after notice to proceed, the controls contractor shall submit the following regarding the LIT: name; address; telephone number; certification of training on this system; list of two projects of similar size and complexity to this contract which were directly supervised by the LIT; and for each project the project name, location, description, cost, name and telephone number of the contracting officer and current facility administrator and date of completion. A replacement to the LIT must be approved in writing by the Owner.

D. Acceptance. A review of the qualifications and action upon the acceptance of the manufacturer and the LIT and LP will be completed by the Owner. If the manufacturer, the proposed product line or the qualifications of the LIT or LP are not in accordance with the Contract Documents or, in the opinion of the Owner, will not result in a satisfactory completed product, alternatives must

be submitted for approval.

PART 2 – PRODUCTS

2.1 TREND LOGGING CAPABILITIES

A. The control system installed shall be capable of and set up to readily trend data with the following minimum features.

1. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC controller's point group.

2. Collection may be by either pre-defined time interval or upon a pre-defined change of value (COV).

3. Each DDC controller panel shall have a dedicated RAM-based buffer for trend data and shall be capable of storing at least 10,000 samples.

4. At least six columns of data can be viewed on the screen at once and can be graphed using a graphing program integral to the control system, with at least four parameters graphed against time on the same graph. The columnar format shall have time down the left column with columns of data to the right (one column for each parameter).

5. The system shall have the ability to graph real-time data of up to four points on the EMS at once, giving each point its own scale.

6. Without any special or difficult conversions, this data shall be able to be designated to be stored as an ASCII delimited file in the same columnar format for use in graphing with normal commercial spreadsheet software.

7. The trend log data is automatically downloaded at appropriate intervals onto the hard drive when space in the field cabinets becomes full, so that no data is lost. This is done without the user having to calculate the size of the trends and download frequency.

8. Any limitations in the trending as to speed of sampling vs number of sampled points in a given trend, and the effect on actual sampling rate and simultaneousness of the sampling across parameters shall be clearly explained in writing. Programming and trending setup examples of all representative situations shall be provided.

9. The trends shall be capable of being set up to start sampling all trended points in a given trend or group of trends at the same exact time.

10. Specifications for standard trends shall be able to be set up by the user and be saved by a name and initiated by only recalling the name. The control contractor shall assist the operators in setting up at least six standard trends during training.

11. A key for the names and definitions of all point abbreviations (both physical and virtual) shall be provided.

12. The system shall have the ability to automatically accumulate and store run-time hours of digital input and output points and to count events (totalization and counting functions).

13. Ideal, but not required, shall be the capability to graph with the control system software, one or more points against another, rather than just against time.

2.2 TEMPORARY PROGRAMMING AND TESTING TERMINAL

A. If the permanent terminal and display is graphical for viewing values and setpoints, and the update time for the graphical display is considered by the CxA to be too slow, the controls contractor shall provide and set up, during the entire functional testing process, a second input and output terminal with a text based format (in addition to the graphics-capable permanent terminal), which will significantly speed up the point readout update time. Both terminals will be simultaneously active.

2.3 GLOBAL COMMAND CAPABILITY

A. The system shall be capable of executing from the central control terminal, temporary or permanent global commands, such as a change in space temperature setpoint.

2.4 COMMISSIONING AND MONITORING POINTS

A. All control points of the central building automation system, required to automatically control the equipment specified in the Contract Documents and to execute all specified control sequences, shall be installed and be able to be monitored.

PART 3 – EXECUTION

3.1 SUBMITTALS

A. The controls contractor shall submit the manufacturer and lead installation technician data according to Part 1 of this section. Upon acceptance, proceed with shop drawings and other submittal data.

B. The controls contractor shall follow the other submittal requirements in Section 23 08 10 and 01 91 13.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Pipe and Pipe Fittings

B. Heating Water Piping System

C. Chilled Water Piping System

1.2 RELATED WORK

A. Section 23 00 00 - General Provisions

B. Section 23 05 16 - Expansion Compensation

C. Section 23 05 29 – Supports and anchors

D. Section 23 05 53 - Mechanical Identification

E. Section 23 07 00 - Piping and Equipment Insulation

1.3 REFERENCES

A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Galvanized, Welded and Seamless.

B. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9.

1.5 QUALITY ASSURANCE

A. Valves: Manufacturer’s name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ANSI/ASME Sec. and applicable State Labor Regulations.

1.6 SUBMITTALS

A. Submit shop drawing and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Include data on pipe materials, pipe fittings, valves, and accessories.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 60 00 – Materials and equipment.

B. Store and protect products under provisions of Section 01 60 00 – Materials and Equipment.

PART 2 PRODUCTS

2.1 HEATING WATER PIPING

A. Steel Pipe: ASTM A53, Schedule 40 ERW.

B. Piping terminal heating coils (3' max.) Type M hard drawn copper, ASTM 88, wrought copper fittings.

2.2 CHILLED WATER PIPING - (ABOVE GROUND)

A. Steel pipe: ASTM A53, Schedule 40, ERW.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. For piping materials see piping section.

B. All A.H. unit drains shall have cleanouts.

C. All A.H. unit auxiliary drains shall be piped separately from primary drains to floor drains.

D. Drain piping (A.H. units) copper tubing type M, hard drawn, ASTM 88 wrought copper fittings.

2.4 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 inches and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe size over 2 inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene.

2.5 VALVES

A. For valves in hydronic systems, see Valve Section 23 05 23.

2.6 RELIEF VALVES

A. Bronzed body, teflon seat, stainless steel stem and springs, automatic.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space and other work.

C. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Provide clearance for installation of insulation, and access to valves and fittings.

E. Provide access where valves and fittings are not exposed.

F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

H. Prepare pipe and fittings, supports, and accessories for finish painting. Refer to Section 09 91 23 – Interior Painting.

3.3 APPLICATION

A. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

B. Install ball or butterfly valves for throttling, bypass, or manual flow control services.

C. Provide spring loaded check valves on discharge of condenser water pumps.

D. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

E. Use lug end butterfly valves to isolate equipment.

F. Provide 3/4 inch ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to drain if specified on drawings.

END OF SECTION 23 21 13

SECTION 23 21 16 - HYDRONIC SPECIALITIES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Air vents.

B. Flow indicators, controls, meters.

1.2 RELATED WORK

A. Section 23 21 13 - Hydronic Piping

1.3 REFERENCES

A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME Boilers and Pressure Vessels code Section 8D for manufacturer of tanks.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Submit shop drawings and product data for manufactured products and assemblies required for this project.

C. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 23 Operation and maintenance Data.

B. Include installation instruction, assembly views, lubrication instructions, and replacement parts lists.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 60 00 – Material and Equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Certain items in this Specification are listed by manufacturer and/or manufacturer's model number to establish general style, type, character, and quality of product desired. Similar items manufactured by other than those listed will be considered, providing submittals are

made according to Pre-Bid Approval requirements of Instructions to Bidders, page IB-3, Paragraph 4.3.

B. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used but Pre -Bid Approval is required.

2.2 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8" brass needle valve at top of chamber.

B. Float Type: Brass or semi-steel body, copper float, stainless steel valve and valve seat; suitable for system operating temperature and pressure, with isolating valve.

C. Washer Type: Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.3 STRAINERS

A. Size 2" inch and under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2" to 4" flanged iron body for 175 psig working pressure, Y pattern with 1/8" stainless steel perforated screen.

C. Size 5 inch and larger: Flanged iron body for 175 psig working pressure, Y pattern with 1/8" stainless steel perforated screen.

2.4 FLOW METERS

A. Heavy duty, 316 stainless steel pitot tube type flow measuring sensor with instrument connections with valves 1/4" SAE flare by 1/8" female NPT brass valves on 1/8" male NPT fittings.

B. Portable meter consisting of case containing one, 3 percent accuracy pressure gauge with 0-60 feet pressure range; two, 3 percent accuracy pressure gauges with 0-135 inches and 0-60 feet pressure ranges for 500 psig maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.5 ACCEPTABLE MANUFACTURERS

A. Annubar with Eagle Eye flow meter or approved equal.

B. PRESCO Annular with model GM meter or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer’s instructions to permit intended performance.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to

nearest drain.

E. Provide valved drain and hose connection on strainer blow down connection.

END OF SECTION 23 21 16

SECTION 23 21 23 - PUMPS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes all pumps except where integral with manufactured piece of equipment.

1.2 RELATED WORK

A. Section 23 21 13 - Hydronic Piping

B. Section 23 05 23 - Valves

C. Section 23 05 29 - Supports and Anchors

D. Section 23 07 00 - Piping and Equipment Insulation

E. Section 22 10 00 - Plumbing Piping

1.3 REFERENCES

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Sections 01 33 00 – Submittal Procedures & 23 00 00 – General Mechanical.

B. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S FRAME MOUNTED END SUCTION PUMPS

A. Aurora 340 Series

B. Bell & Gossett Model 1510

C. Taco KV/KS Series

D. Paco LF Series

E. Armstrong 4030 Series

F. Patterson VIL Series

G. Pump supplier shall be an authorized factory distributor for equipment supplied.

2.2 GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction to permit complete servicing without breaking piping or motor connections.

C. Pumps to operate at 1750 rpm unless specified otherwise.

D. Pump connections to be flanged.

2.3 BASE MOUNTED PUMPS (Hot water heating)

A. Type: Centrifugal, single stage, direct connected.

B. Casing: Cast iron, split volute, single or double suction, renewable bronze wearing rings, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Shaft: High grade alloy steel with copper, bronze or stainless steel shaft sleeves.

E. Bearing: Oil lubricated roller or ball bearings with oil reservoirs. Provide oil seal and integral dirt and water seal at each end of reservoir.

F. Drive: Flexible coupling with coupling guard.

G. Seals: Pumps shall have mechanical seals and hardened 316 stainless steel short sleeve.

H. Baseplate: High grade heat treated cast iron or reinforced heavy steel with integral drain rim grout base.

I. Non overloading.

J. Bearing shall be grease proof bearing cartridges. Shaft deflection shall not exceed .002 at stuffing box.

K. Bearings shall be designed for average life of ten years and bearing arms are to be cast integral with lower half of casing to assure proper bearing alignment.

L. Pumps shall be horizontal split case with casing suitable for 250 psi case wearing pressure. (Chilled water, heating water pumps - end suction type).

M. Impellers shall not exceed 90% of maximum published diameter.

N. Furnish two (2) spare seals for each pump.

O. Pump impeller diameter shall be selected such that break hp will not exceed specified hp at any operating point which exists on that particular impeller diameter pump curve.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide drains for bases and stuffing boxes piped to and discharging into floor drains.

B. Provide air cock and drain connection and horizontal pump casings.

C. Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sized 4 inches and over.

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are maximum efficiency curve.

E. Qualified millwright to check, align, and certify base mounted pumps prior to start-up.

3.2 PUMP SCHEDULE: See Plans.

END OF SECTION 23 21 23

SECTION 23 25 00 - CHEMICAL (WATER) TREATMENT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Cleaning of piping systems.

B. Chemical feeder equipment.

C. Treatment for closed systems.

D. Treatment for open system.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 21 13 - Hydronic Piping: Water coupon rack, by-pass (pot) feeder.

1.3 RELATED SECTIONS

A. Section 23 21 13 - Hydronic Piping

B. Section 23 21 16 - Hydronic Specialties

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Submit shop drawings indicating system schematics, equipment locations, and controls schematics.

C. Submit product data indicating chemical treatment materials, chemicals, and equipment.

D. Submit manufacturer's installation instructions under provision of Section 01 33 00 – Submittal Procedures.

E. Submit reports indicating start-up of treatment systems are completed and operating properly.

F. Submit reports indicating analysis of system water after cleaning and after treatment.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 23 – Operation and Maintenance Data.

B. Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs.

C. Include step by step instructions on test procedures including target concentration.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.7 REGULATORY REQUIREMENTS

A. Conform applicable EPA code for addition of non-potable chemical to building mechanical systems, and for delivery to public sewage systems.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of treatment systems for one (1) year from date of Substantial Completion.

B. Provide monthly technical service visits to perform field inspection and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two (2) copies of field service report after each visit.

C. Provide laboratory and technical assistance service for warranty period.

D. Include two hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start-up of systems.

E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.9 MAINTENANCE MATERIALS

A. Submit maintenance materials under provisions of Section 01 78 23 – Operation and Maintenance Data.

B. Provide sufficient chemicals for treatment and testing during warranty period.

1.10 APPROVAL OF PRODUCT PRIOR TO BIDDING

A. Refer to Section 01 60 00, Material and Equipment, paragraph, 1.4, 1.4A and 1.4B for product prior approval requirements.

B. Contractor must coordinate with TGHS prior to ordering any equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Certain items in this Specification are listed by manufacturer and/or manufacturer's model number to establish general style, type, character, and quality of product desired. Similar items manufactured by other than those listed will be considered, providing submittals are made according to Pre-Bid Approval requirements of Instructions to Bidders.

B. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used and Pre-Bid approval is not required.

2.2 MATERIALS

A. System Cleaner:
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
   2. Algicide.

B. Closed System Treatment (Water):
1. Sequestering agent to reduce deposits and adjust ph (polyphosphate).
2. Corrosion inhibitors: (liquid) boron-nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
3. Conductivity enhancers: phosphates or phosphonates.

C. Condenser Water System Treatment (Cooling Towers)
1. Sequestering agent to inhibit scaling; phosphonates, sodium polyphosphates, lignin derivatives, synthetic polymer polyelectrolytes, or organite phosphates.
2. Acid to reduce alkalinity and ph.
3. Corrosion inhibitor: Zinc-phosphate, phosphonate-phosphate, phosphonate-molybdate and phosphonate silicate, sodium tolyltriazole, or low molecular weight polymers.
4. Algicide: Chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

2.3 EQUIPMENT

A. By-pass pot feeder: Quick opening for working pressure of 175.

B. Drip Feeder: Plastic reservoir with coil of capillary tubing with probe, weight, charging syringe, and clip.

C. Solution Metering Pump: Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous-duty fully enclosed electric motor and drive, and built in relief valve.

D. Solution Tanks: 50 gallon capacity, polyethylene, self-supporting, 5 gallon 3.8 graduated Markings; molded fiberglass cover with recess for mounting pump, agitator, and liquid level switch.

E. Agitator: Totally enclosed, explosion proof electric motor, stainless steel clamp and motor mount, 5/8 inch diameter Type 316 stainless steel propeller.

F. Liquid Level Switch: Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump, and low level alarm.

G. Conductivity Controller: Packaged monitor controller with solid state circuiting, five percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and circuit and recorder.

H. Water Meter: Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.

I. Solenoid Valves: Forged brass body globe pattern, normally open or closed as required, general purpose solenoid enclosure, and continuous duty coil.

J. Timers: Electronic timers, infinitely adjustable over full range, 150 second and five minute range, mounted together in cabinet with hands-off-automatic switches and status lights.

2.4 TEST EQUIPMENT

A. Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4-10 zeroing titrating burettes and associated reagents.

B. Provide the following test kits:
1. Alkalinity titration test kit.
2. Chloride titration test kit.
3. Sulphite hardness titration test kit.
4. Total hardness titration test kit.
5. Low phosphate test kit.
6. Conductivity bridge, range 0-10,000 microhms.
7. Creosol red ph slide complete with reagent.
8. Portable electronic conductivity meter.
9. High nitrite test kit.

PART 3 EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

A. Add cleaner to closed systems at concentration as recommended by manufacturer.

B. Hot Water Heating Systems: Apply heat while circulation slowly raising temperature to 160 degree F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.

C. Chilled Water Systems: Circulate for forty eight hours, then drain systems as quickly as possible. Refill with clean water, circulate for 24 hours, then drain. Refill with water and repeat until system cleaner is removed.

D. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect.

E. Flush open systems with clean water for one hour minimum. Drain completely and refill.

F. Remove, clean, and replace strainer screens.

G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around globe valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

3.5 CONDENSER WATER SYSTEMS (COOLING TOWERS)

A. Provide automatic condenser water control systems for inhibitor feed, blowdown and biocide feeds. Inhibitor application shall be meter activated, blowdown shall be conductivity activated, and biocide shall be meter fed with blowdown locked out to insure biocide retention time.

B. Control system shall incorporate solid state integrated circuits and digital LED displays, in NEMA-12 steel enclosure. Provide gasketed and lockable door.

C. Base dissolved solids control on conductivity and include:
1. LED digital readout display (microhm/cm).
2. Temperature compensated sensor probe adaptable to sample stream manifold.
3. High, low, normal conductance indicator lights (LED).
4. High or low conductance alarm light (flash or steady switch shall have silence position.
5. Illuminated legend shall indicate "ALARM" whenever alarm condition exists.
6. Hand-off-automatic switch for solenoid bleed valves.
7. Illuminated legend shall indicate "BLEED" when valve is operated.
8. Adjustable hysteresis or dead-band (internal).

D. Base inhibitor feed control on make-up volume and include:
1. Solid state counter (1-125 field selectable).
2. Solid state timer (adjustable 1/4 to 5 minutes).
3. Test switch.
4. Hand-off-automatic switch for chemical pump.
5. Illuminated legend shall indicate "FEED" when pump is activated.
6. Solid state lock-out timer (adjustable 1/4 to 3 hours) and indicator light. Lock-out timer shall deactivate the pump and activate alarm circuits.
7. Panel totalizer (amount of makeup), electro-mechanical type.

E. Biocide programmer to include:
1. 24 hour timer with 14 day skip feature to permit activation any hour of the day.
2. Precision solid state bleed lock-out timer (0-9 hours) and biocide pump timer (0 - 2 - 1\4 hours), clock controlled.
3. Solid state alternator to enable the use of two different formulations.
4. Digital display of the time of day (24 hours).
5. LED display of day of week (14 days).
6. Fast and slow clock set controls (internal).
7. Battery back-up so clock is not disturbed by power outages, quartz timekeeping accuracy.
8. Hand-off-automatic switches for biocide pumps.
9. Illuminated legend shall indicate "BIOCIDE A" or "BIOCIDE B" when pump is activated.

F. Provide water meter on system make-up, wired to control system.

G. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.

H. Provide conductivity controller to sample condenser water and operate 11 inch solenoid bleed valve and piping to blow down controller sampler wired to open when condensing water pump is operating.

I. Introduce algicide to tower by intermittent slug feed.

J. Provide liquid level switch in each solution tank to deactivate solution pump and agitator, and sound local alarm bell.

K. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

END OF SECTION 23 25 00

SECTION 23 31 00 – DUCTWORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. Low pressure duct.

B. Medium and high pressure duct.

C. Fire and Smoke Dampers

1.2 RELATED WORK

A. Section 23 05 23 - Supports and Anchors

B. Section 23 07 00 - Piping and Equipment Insulation

C. Section 23 36 00 - Air Terminal Units

D. Section 23 37 00 - Air Outlets and Inlets

E. Section 23 05 93 - Testing Adjusting and Balance

1.3 REFERENCES

A. ASHRAE, 2009 Fundamentals, Chapter 21.

B. ASHRAE, 2008 Equipment, Chapter 18.

C. NFPA 90A, 90B.

D. H.V.A.C. Duct Construction Standards - SMACNA 1995.

1.4 DEFINITIONS

A. Duct sizes: Inside clear dimensions for wrapped ducts, maintain sizes inside lining. Metal to metal sizes for internally lined ductwork.

B. Low Pressure: Three pressure classifications: 1/2" WG positive or negative static pressure and velocities less than 2,000 fpm, 1" WG positive or negative static pressure and velocities less than 2,500 fpm and 2" WG positive or

C. Medium Pressure: Three pressure classifications: 3 inch WG positive or negative static pressure and velocities less than 4,000 fpm, 4" WG positive static pressure and velocities greater than 2,000 fpm. 6" WG positive static pressure and velocities greater than 2,000 fpm.

1.5 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and NFPA 90B Standards.

B. Store and protect products under provisions of Section 01 60 00 Materials and Equipment.

C. Construct ductwork to International Mechanical Code Standards

PART 2 PRODUCTS

2.1 MEDIUM PRESSURE DUCTWORK

A. All ductwork on high velocity systems shall be flat oval and/or round type constructed as per latest edition of ASHRAE Guide and as shown on the plans, and shall be absolutely air tight. Round ductwork as shown and required shall be furnished.

B. Metal gauges for single wall round and flat oval duct shall be as follows:

1. ROUND DUCTS

Duct diameter Longitudinal	Spiral Pipe	Fittings and seam pipe
3" thru 14"	26	24
15" thru 26"	24	22
27" thru 36"	22	20
37" thru 50"	20	20

2. FLAT OVAL DUCTS

Major Dimension Longitudinal	Spiral Pipe	Fittings and seam pipe
Up to 24"	24	20
25" thru 36"	22	20
37" thru 48"	22	18
49" thru 60"	20	18
61" thru 70"	20	16

C. Longitudinal joints shall be grooved seam type; and joints shall be male and female slip type, with maximum tolerance of 1/64" between outside diameter of male and inside diameter of female end.

D. Interior of all ductwork shall be smooth and each length shall be carefully inspected after construction and any defects removed.

E. Forty-five (45) degree elbows shall be of the three-piece construction. Ninety degree (90) elbows shall be five-piece construction. Center line radius of elbows shall not be less than 1-1/2 times the pipe diameter.

F. As shown on plans, take-off to mixing boxes are 45 degree take-off.

G. Ample length of duct, branch connection, tees, 45 degree and 90 degree elbows shall be submitted for approval of design and workmanship before any construction is commenced.

H. Mastic shall be applied to male duct end, joints pushed together surplus mastic removed and the joint finished with hard cast "iron grip".

I. All connections between ductwork and attenuating chambers shall be made with pre-insulated flexible air duct, minimum 24" in length.

J. Flexible duct shall be clamped to round pipe of branch connections and attenuator chamber stub with clamps, with mastic or tape applied to the male ends of the stubs before insertion into the flexible duct. Mastic and tape must comply with UL181A & UL181B.

K. All ductwork shall be thoroughly supported and braced according to latest edition of ASHRAE Guide & SMACNA Manual.

L. On completion of medium pressure duct and before connection of mixing boxes to system, all open ends shall be tightly closed and air pumped into duct system until an air pressure of one and a half times external static pressure specified for the air handling unit serving this ductwork is obtained.

M. This pressure shall be maintained until all joints are inspected and examined for leaks.

N. All leaks shall be repaired immediately.

O. The above work shall be completed before any furring or ceiling work is started by General Contractor.

P. Flexible connections shall be provided in high pressure supply ductwork between the duct and equipment.

Q. All supply flat oval ductwork thru first 20 feet of A.H. units shall be double wall insulated with perforated liner sound attenuating duct and fittings. (VAV Units only)

R. All medium and high pressure duct shall be spiral ductwork with anti-microbial coating from factory.
1. All spiral ductwork surfaces shall have a factory applied antimicrobial coating, which complies with all items in this section.
2. The active agent of the antimicrobial coating must be registered with the Environmental Protection Agency (EPA) specifically for internal use in HVAC systems. Submittals must include a copy of the EPA certification with MSDS reports.
3. Applied coating must be tested at an independent laboratory for efficacy and show effectiveness against fungi and bacteria.
4. Products should be independently tested to show compliance with applicable fire codes, ASTM and UL codes.
   a. Antimicrobial coating for duct systems must meet or exceed the following ratings as tested to UL-723.
      1) Smoke Developed = 0
      2) Flame spread = 0
5. Coating shall be non-toxic and shall not release active ingredient into the air stream.
6. Antimicrobial coating shall be uniformly, factory applied to ensure complete (100%) coverage on the specified surface. No bare un-coated surfaces will be accepted.
7. All excess metal and non-metal materials with antimicrobial coating must be capable of disposal without requiring and hazardous waste permit.
8. Blemishes over ¼" wide shall be recoated at job site provided field touch-up coating maintains full antimicrobial performance.
9. Acceptable antimicrobial coating products are; AVRON46.
10. Insulating materials used in the HVAC system will be independently tested to resist the growth of mold and bacteria.
11. Products stored on the job site should be properly protected to reduce the likelihood of contamination prior to installation.
12. Joining compounds such as caulks and mastics shall be UL listed per UL-181.

S. All ductwork delivered to the job site shall have the ends covered with visqueen and taped to maintain the cleanliness of the interior of the ductwork.

2.2 INSULATED MEDIUM AND HIGH PRESSURE FLEXIBLE DUCT

A. Provide where indicated on drawings Flexmaster Type 4M UL181 Class I Air Duct. Approved equal:

Thermaflex model MK-C or prior approved equal with sample submitted during prior approval stage.

B. The duct shall be constructed of a heavy coated fiberglass cloth fabric supported by helical wound galvanized steel. The fabric shall be mechanically locked to the steel helix without the use of adhesives or chemicals.

C. The internal working pressure rating shall be at least 12" w.g. positive and 5" w.g. negative with a bursting pressure of at least 2½ time the working pressure.

D. The duct shall be rated for a velocity of at least 5500 feet per minute.

E. The duct must be suitable for continuous operation at a temperature range of -20° F to +250°

F. Factory insulate the flexible duct with fiberglass insulation. The R value shall be at least 5 minimum (R-4.2 is not acceptable) at a mean temperature of 75° F.

G. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure A.

H. Maximum length to be 2’-0”.

2.3 LOW PRESSURE DUCTWORK

A. Furnish and install all ducts for the air conditioning, heating and ventilating systems. Ductwork shall be complete with grilles, vanes splitters, flashings, hangers, flexible connections, manual dampers, fresh air inlet louvers, reinforcing angles, transitions to equipment, etc.

B. All low pressure ductwork (mean velocity less than 2,000 FPM and static pressure in duct 2" of water or less) shall be constructed as per SMACNA Standards, 1995 Edition, Chapter 1, and shall be of the gauge metal and reinforced as per SMACNA Standards, 1995 Edition.

C. Flashing shall be of the same material as specified under the roofing and flashing section of these specifications, or of 16-ounce sheet copper and shall be furnished and installed around all outside openings used for ducts or fans where required. Roof flashing shall extend at least 8" above roof. Cooperate with roofing contractor when installing flashing.

D. All duct connections to equipment shall be made with fire and mildew resistant flexible connections of canvas or other acceptable materials. Connections shall have suitable metal collar frames at each end and shall not be less than 4" long with at least 1" of slack in the connection. Flexible connections shall be heat resistant to 500 degrees F continuously.

E. Duct dimensions shown are metal sizes. All edges shall be straight and true.

F. All flexible connections, duct liner and adhesives shall be U.L. listed as having a maximum flame spread of 50, fuel contribution of 25 and smoke contribution of 25.

G. This Contractor shall furnish and install in ductwork all dampers, vanes splitters, etc.. as shown on the drawings or necessary to make the system complete. Where dampers or splitters can not be accessed through lay in ceiling, Contractor shall provide lockable 24” x 24” access door. Contractor shall coordinate location with Architect.

H. Shafts shall be marked to show position of dampers, vanes, splitters, etc.

I. Ductwork shall be supported in accordance with SMACNA Plate No. 17 and No. 18, up to and including band iron hangers attached to duct by means of screws or rivets per hanger.

J. Access doors shall be provided in ductwork for all automatic dampers and each manual damper 3 square feet in area or larger, and shall be so located that damper can be completely serviced through the access door. Access door shall be provided with felt gaskets and suitable hinges and locks. Where access doors occur in insulated duct, double skin insulated doors shall be used.

K. Where square ducts are shown, provide single vane elbows as per Plate 22, Figure A, SMACNA Standards, 1995 Edition. For all ductwork over 18" provide double vane square elbow as shown in Figure C of the Plate.

L. All low pressure ductwork joints shall be sealed with hard cast "iron grip".

M. Flexible air duct for connections between low pressure rectangular duct and ceiling diffusers shall be pre- insulated and listed by Underwriters Laboratories under U.L Standard 181 as a Class 1 flexible air duct and complying with NFPA Standards 90A and 90B.

N. All flex duct 45 degree and 90 degree turns shall be metal hard duct.

O. All ductwork and accessories associated with any pool air condition unit or pool exhaust shall be aluminum.

2.4 INSULATED ACOUSTICAL LOW PRESSURE FLEXIBLE DUCT

A. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel.

B. Provide where indicated on drawings Flexmaster Type 8M UL181 Class I Air Duct.

C. Fabric shall be mechanically locked to the steel helix without the use of adhesives or chemicals.

D. The internal working pressure rating shall be at least 6" w.g. positive and 4" w.g. negative with a bursting pressure of at least 2½ time the working pressure.

E. The duct shall be rated for a velocity of at least 4000 feet per minute.

F. The duct must be suitable for continuous operation at a temperature range of -20° F to +250°

G. Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties, shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM 477, at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	7	31	40	38	40	27
8" diameter	13	29	36	35	38	22
12" diameter	21	28	29	33	26	12

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	5	8	7	8	11	15
8" diameter	10	7	7	8	10	13
12" diameter	9	6	6	5	9	13

The self generated sound power levels (LW) dB re 10^{-12} Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	54	45	38	31	27	23

Factory insulate the flexible duct with fiberglass insulation. The R value shall be at least 5.0 at a mean temperature of 75° F. (R-4.2 is not acceptable)

H. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure A.

I. Maximum length to be 3’-0

ALL FLEX CONNECTIONS TO CEILING DIFFUSERS MUST BE FACTORY DESIGNED TO HAVE NO DIMENSIONAL CONTORTION WHEN CONNECTED TO THE DIFFUSER.

2.5 FIRE AND SMOKE DAMPERS

A. Round and oval fire dampers shall be designed for high pressure duct systems.

B. Rectangular fire dampers shall be designed for low pressure duct systems.

C. All fire dampers must be NFPA 90A and UL approved.

D. Furnish and install access doors in ductwork, walls, and ceilings where required to service all fire dampers, smoke dampers and detectors. All fire and smoke dampers shall be installed by the sheet metal contractor. All smoke detectors shall be furnished by the electrical Sub-contractor. Control of smoke dampers shall be coordinated with fire alarm system and building automation system.

E. Rectangular Smoke Dampers - Louvers Dampers Inc. Model SD-400-UD or Ruskin FSD-35 tight seal parallel blade smoke dampers with low leakage and felted blades.

F. Round and Oval Smoke Dampers - Shall be same as above but complete with welded round or oval

collars. Units shall be capable of handling pressures up to 6" W.G.

G. Smoke dampers shall be Class I rated as per UL 555.

H. Sheet metal contractor shall provide and install all smoke dampers and actuators. Dampers shall be provided with end switches

I. Approved Manufacturers: Pottorff, Ruskin, Price, Nailor Industries, Greenheck, or prior approved equal.

2.6 LOW LOSS TAP

A. All round low pressure connections to rectangular ducts shall be made with a factory fabricated 45 degree low loss entry “shoe” tap with damper constructed of minimum 26 gage galvanized steel. The damper shall have a 2” raised handle with a high quality locking quadrant. A 3/8” continuous rod with “U” bolts connects the damper to the rod. Nylon end bearings are required where the rod penetrates the spin collar barrel.

B. Provide Flexmaster #STOD-BO3, Dace # 26 ga STOD-C03, or prior approved equal.

C. For medium pressure systems where used upstream of VAV terminals, the damper can be eliminated (use Flexmaster #STO or Dace 24 ga STO). Gauge shall be 24 gauge on medium pressure systems.

2.9 DUCT AIR LEAKAGE TESTING

A. Ductwork that is designed to operate at static pressures exceeding 3 inches water column and all ductwork located outdoors shall be leak-tested in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Positive pressure testing is acceptable for negative pressure ductwork. The maximum permitted duct leakage shall be in accordance with Equation 6-7.

PART 3 EXECUTION

3.1 INSTALLATION

A. See details of ductwork symbols and connections on drawings.

END OF SECTION 23 31 00

SECTION 23 34 10 - GENERAL EXHAUST SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. This Section includes general and exhaust fans with accessories.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 23 Sections apply to this section:
1. "GENERAL MECHANICAL ."
2. "BASIC MATERIALS AND METHODS."

C. Related Sections: The following sections contain requirements that relate to this section:
1. Division 23, Section 23 05 93 "TESTING, ADJUSTING, AND BALANCING" for air-handling systems testing, adjusting, and balancing requirements and procedures.
2. Division 23 Section 23 09 00 – HVAC TEMPERATURE CONTROLS

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 Submittal Procedures.

B. Product data for selected models, including specialties, accessories, and the following:
1. Fan performance curves with system operating conditions indicated.
2. Fan sound power ratings.
3. Motor ratings and electrical characteristics plus motor and fan accessories.
4. Materials gages and finishes.
5. Dampers, including housings, linkages, and operators.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Maintenance data for inclusion in Operating and Maintenance Manual.

1.4 QUALITY ASSURANCE

A. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

B. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Certain items in this Specification are listed by manufacturer and/or manufacturer’s model number to establish general style, type, character, and quality or product desired. Similar items manufactured by other than those listed will be considered, providing submittals are made according to Pre-Bid approval requirements of Instruction to Bidders.

B. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used and Pre-Bid Approval is not required.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Exhaust Fans:
a. Greenheck GB Series
b. Acme PL Series
c. PENN/Barry
d. Twin City

2.3 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:
1. Sound Power Level Ratings for General Exhaust Fans: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code For Sound Rating." General exhaust fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency shall be factory tested and ratings in accordance with AMCA Standard 210/ASHRAE STANDARD.

2.4 DIRECT AND BELTED SPUN ALUMINUM POWER ROOF VENTILATORS

A. General Description:
1. Direct Drive: Roof exhaust fans shall be centrifugal direct drive type.
2. The fan wheel shall be centrifugal backward incline, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
3. The fan housing and schroud shall be constructed of heavy gauge aluminum with a ridged internal support structure. The fan shroud shall have a rolled bead for added strength.
4. Motors shall be out of the air stream on vibration isolators. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance.
5. A disconnect switch shall be factory installed and wired from the fan motor to a junction box within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

B. GENERAL DESCRIPTION: Belt Drive
1. Belt Drive Centrifugal Roof Exhausters shall have centrifugal forwardly inclined wheels, constructed of aluminum and shall include a wheel cone carefully matched to the inner cone for precise tower running. Wheels shall be statistically and dynamically balanced.
2. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan schroud shall have a rolled beam for added strength.
3. Motors shall be heavy duty ball bearing type carefully matched to the fan mode and furnished at the specified voltage, phase and enclosure. Motors and drive shall be mounted on vibration isolators, out of the air stream. Fresh air for motor shall be drawn in the motor compartment from an area free of discharge contaminants. Motors shall be accessibly for maintenance.
4. Drive frame assembly shall be constructed of heavy gauge steal and mounted on vibration isolators
5. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in access of

200,000 hours at maximum catalog operating speed.

6. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully matched cast iron type, keyed and securely attached to the wheel and motor shaft. Motor pulleys shall be adjustable for final system balance.
7. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.
8. All fans shall bear AMCA Certified Ratings Seal for sound and air performance.
9. Each fan shall bear a permanently affixed manufacturer's name plate containing the model number and individual serial number for future identification.

END OF SECTION 23 34 10

SECTION 23 34 23 - POWER VENTILATORS

PART 1 GENERAL

1.1 WORK INCLUDED

A. In-line Exhaust Fans

1.2 RELATED WORK

A. Section 23 05 13 - Motors

B. Section 23 31 00 - Ductwork

1.3 REFERENCES

A. AMCA 99 - Standards Handbook

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes

C. AMCA 300 - Method of Publishing Sound Ratings for Air Moving Devices

D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices

E. SMACNA - Low Pressure Duct Construction Standard

1.4 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Sound Rating Seal.

B. Sound Rating: AMCA 301, tested to AMCA 210 and bear the AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Provide product data on wall and roof exhausters, and ceiling and cabinet fans.

C. Provide fan curves with specified operating point clearly plotted.

D. Submit sound power levels for both fan inlet and outlet at rated capacity.

E. Submit manufacturer's installation instructions under provisions of Section 01 33 00 – Submittal Procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Certain items in this Specification are listed by manufacturer and/or manufacturer’s model number to establish general style, type, character, and quality of product desired. Similar items manufactured by other than those listed will be considered, provided submittals are made according to Pre-Bid Approval requirements of Instructions to Bidders, Page IB-3,

Paragraph 4.3.

B. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used and Pre-Bid Approval is not required.

2.2 ACCEPTABLE MANUFACTURERS

A. Greenheck, Model BSQ

B. Cook, Model SQN

C. Substitutions: Under provisions of Section 01 33 00 Submittal Procedures.

2.3 ACCESSORIES

A. Exhaust fans shall have backdraft dampers.

B. ECM Motors.

C. Speed controller is no on VFD.

D. Direct drive.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 SCHEDULE – see plans

END OF SECTION 23 34 23

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable volume terminal units.

B. Variable volume regulators.

C. Integral heating coils.

D. Integral damper motor operators.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 09 00 – HVAC Temperature Controls

1.3 RELATED SECTIONS

A. Section 23 31 00 - Ductwork

1.4 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. UL 181 - Factory-Made Air Ducts and Connectors.

C. ARI 880 - Air-Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals

D. UL - Shutoff terminal must be UL listed as a Room Air Terminal.

E. ASTM A653/A653M, A924/A924M Steel Sheet, Zinc Coated Galvanized.

F. NFPA 90A, Lining

1.5 SUBMITTALS

A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.

B. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and radiated sound power levels (2nd through 7th octave bands) at design maximum operating conditions. Also submit Radiated Sound NC values shall be calculated at design conditions with the following path attenuation credits:

Correction to Octave Band Sound Power Value

	2	3	4	5	6	7
ENV. ADJ.	-3	-2	-1	-1	-1	-1
Mineral Fiber Ceiling Tile	-9	-10	-12	-14	-15	-15
Space Effect Factor	-10	-11	-12	-13	-13	-14

This transfer function represents modeling assumptions based on ARI 885-90.

C. Submit manufacturer's installation instructions.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, maintenance, and repair data.

C. Include directions for resetting all DDC controls.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section.

1.8 SYSTEM RESPONSIBILITY

A. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as "basis of design".

1.9 WARRANTY

A. Provide one year manufacturer's labor & parts warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. General
1. Manufacturers must participate in the ARI Certification program. Unit performance data must be Rated in Accordance with ARI Standard 880, and must display the ARI Symbol on all standard units.
2. Shutoff terminals must be UL listed as a Room Air Terminal.

B. Specified Manufacturers
1. JCI
2. TITUS
3. Enviro-TEC
4. Nailor Industries
5. Krueger
6. Price

2.2 MANUFACTURED UNITS

A. Air volume supply air control terminals for connection to single medium pressure duct.

B. Identify each terminal unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory set air flow, minimum factory set air flow, and coil type.

C. VAV box manufacturer shall provide enclosure, transformer and factory mounting and wiring of VAV box controls provided by temperature controls contractor.

2.3 FABRICATION

A. Casings. Units shall be completely factory assembled, manufactured of corrosion protected welded screwed steel, and fabricated with a minimum of 18-gauge metal on the high pressure

(inlet) side of the VAV damper and 22-gauge metal on the low pressure (outlet) side and unit casing.

B. INSULATION - Matt - Interior surface of unit casing acoustically and thermally Insulated with a minimum of 1-1/2 inch, R-Value 2.1 1.9 lb./cu. ft. density glass fiber with galvanized sheet metal liner (no exposed fiberglass. Insulation shall be UL listed and meet NFPA-90A and UL 181 requirements. C. Assembly: Air volume damper, and controls shall be in a single cabinet.

2.4 VOLUME DAMPER

A. Locate air volume damper assembly inside unit casing. Construct from extruded aluminum or a minimum of 20 gauge (0.9 mm) galvanized steel components. Key damper blades into shaft with nylon fitted pivot points. Flow sensor must be provided regardless of control chosen. Flow sensor must be a ring or cross. Bar or single point sensing device is not acceptable.

B. Air volume control damper shall be factory calibrated assembly consisting of air valve with integral actuator. All VAV boxes shall be double wall.

C. All VAV boxes shall be double wall. No insulation in air stream

2.5 SEQUENCE OF OPERATION, AIR TERMINAL UNITS

2.6 TESTS

A. Factory set and check all controllers to within 5% of scheduled maximum and minimum settings. Base performance on tests conducted in accordance with ARI 880.

B. Maximum Casing Leakage: 1 percent of nominal air flow at 0.5 in wg inlet static pressure.

C. Maximum Damper Leakage: 1 percent of design air flow at 4 in wg inlet static pressure.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 ADJUSTING

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design air flow to 25 percent nominal air flow. Set units with heating coils for minimum 30 percent full flow.

END OF SECTION 23 36 00

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Diffuser boots.

B. Registers/grilles.

C. Louvers.

1.2 RELATED WORK

A. See Mechanical Plans for wall louvers.

1.3 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers, and Shutters.

C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. ARI 650 - Air Outlets and Inlets.

E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

F. SMACNA - Low Pressure Duct Construction Standard.

1.4 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate performance of louvers in accordance with AMCA 500.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Provide product data for items required for this project.

C. Submit schedule of outlets and inlets indicating type, size, application, and noise level.

D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

E. Submit diffuser, grille and register color data to Architect for approval.

PART 2 PRODUCTS

2.1 GENERAL

A. See mechanical schedules and drawings for diffuser types, sizes and configuration. See architectural plans - room finish schedules for type of ceiling and wall construction.

B. Substitutions: Under provisions of Instructions To Bidders, Page IB-3, Paragraph 4.3.

C. All diffusers, grilles, and louvers located in pool area shall be aluminum.

2.2 ACCEPTABLE MANUFACTURERS - Ceiling Diffusers

A. Titus TMSA Series, Krueger Series 1400 Adjustable

B. All diffusers shall have opposed blade volume dampers and adjustable horizontal to vertical four way throw operable from face of grille. All diffusers must be aluminum.

2.3 ACCEPTABLE MANUFACTURERS - Ceiling Exhaust Grilles

A. Titus - Model 50F Code C 1/2" x 1/2" x 1" Cube Core, Krueger EGC-10, Nailor Industries Model 51EC

B. All exhaust registers shall have opposed blade dampers.

C. Grilles shall have baked enamel white finish.

D. All dampers shall be operable from grille face.

2.4 ACCEPTABLE MANUFACTURERS - Ceiling Return Air Grilles

A. Titus - 50F Code C, Krueger EGC-10, Nailor Industries

B. All return air shall have opposed blade dampers. See plans for filter backed grille requirements.

2.5 ACCEPTABLE MANUFACTURERS - Wall Supply Registers.

A. Titus 1700 Series, Krueger ULTRA-FLO

B. All registers shall have adjustable blade dampers on all registers.

C. Furnish and install opposed blade damper on all registers.

D. Finish to be approved by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturer’s instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and register, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Furnish and install necessary frames, bucks, sponge rubber gasketed, etc. to make a neat setting job.

F. Diffusers shall be placed to insure that air does not blast against columns and lights.

G. All diffusers, registers, etc. shall have external volume controls and deflecting grids.

H. Ceilings in areas where plaster or gypsum board ceiling are used, shall be surface mounted.

END OF SECTION 23 37 00

SECTION 23 61 10 - VARIABLE SPEED WATER-COOLED SCREW CHILLERS

Part 1 — GENERAL

1.1 SYSTEM DESCRIPTION

A. Microprocessor-controlled liquid chiller shall use a semi-hermetic screw compressor using refrigerant HFC-513A only.

B. Approved Manufacturers: Carrier Corp 23XRV

1.2 QUALITY ASSURANCE

A. Chiller performance shall be rated in accordance with AHRI (Air-Conditioning, Heating and Refrigeration Institute) Standard 550/590, latest edition.

B. Equipment and installation shall be in compliance with ANSI/ASHRAE 15 (latest edition).

C. Evaporator and condenser refrigerant side shall include ASME ‘U’ stamp and nameplate certifying compliance with ASME Section VIII, Division 1 code for unfired pressure vessels.

D. A manufacturer’s data report is required to verify pressure vessel construction adherence to ASME vessel construction requirements. Form U-1 as required per ASME code rules is to be furnished to the owner. The U-1 Form must be signed by a qualified inspector, holding a National Board Commission, certifying that construction conforms to the latest ASME Code Section VIII, Div. 1 for pressure vessels. The ASME symbol “U” must also be stamped on the heat exchanger. Vessels specifically exempted from the scope of the code must come with material, test, and construction methods certification and detailed documents similar to ASME U-1; further, these must be signed by an officer of the company.

E. Chiller shall be designed and constructed to meet UL and UL of Canada requirements and have labels appropriately affixed.

F. The management system governing the manufacture of this product is ISO (International Organization for Standardization) 9001:2015 certified.

G. Each compressor assembly shall undergo a mechanical run-in test to verify vibration levels, oil pressures, and temperatures are within acceptable limits. Each compressor assembly shall be proof tested at a minimum 204 psig (1407 kPa) and leak tested at 185 psig (1276 kPa) with a tracer gas mixture.

H. Entire chiller assembly shall be proof tested at 204 psig (1407 kPa) and leak tested at 185 psig (1276 kPa) with a tracer gas mixture on the refrigerant side. The leak test shall not allow any leaks greater than 0.5 oz (14.78 mL) per year of refrigerant. The water side of each heat exchanger shall be hydrostatically tested at 1.3 times rated working pressure.

I. Prior to shipment, the chiller automated controls test shall be executed to check for proper wiring and ensure correct controls operation.

J. Chillers shall have factory-mounted, factory-wired and factory-tested unit-mounted variable frequency drive (VFD). Proper VFD operation shall be confirmed prior to shipment.

1.3 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with manufacturer’s instructions.

B. Unit shall be shipped with all refrigerant piping and control wiring factory installed.

C. Unit shall be shipped charged with oil and full charge of refrigerant HFC-513A.

D. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, chiller model number, chiller serial number, and refrigerant used.

E. If the unit is to be exported, the manufacturer shall provide sufficient protection against sea water corrosion, making the unit suitable for shipment in a standard open top ocean shipping container.

F. Chiller and starter shall be stored indoors, protected from construction dirt and moisture. Chiller shall be inspected under shipping tarps, bags, or crates to be sure water has not collected during transit. Protective shipping covers shall be kept in place until machine is ready for installation. The inside of the protective cover shall meet the following criteria:
   1. Temperature is between 40°F (4.4°C) and 120° F (48.9°C).
   2. Relative humidity is between 10% and 80% non-condensing.

1.4 WARRANTY

A. Warranty shall include complete parts and labor for one year after start-up or 18 months from shipment, whichever occurs first.

B. Extended warranty shall include parts and labor for four years beyond the first year of operation for a total of five years.

Part 2 — PRODUCTS

2.1 EQUIPMENT

A. General: Factory-assembled, single piece, liquid chiller shall consist of compressor, motor, VFD, lubrication system, evaporator, condenser, initial oil and refrigerant operating charges, microprocessor control system, and documentation required prior to start-up.

B. Compressor:
   1. One variable speed screw compressor of the high performance type.
   2. Compressor and motor shall be hermetically sealed into a common assembly and arranged for easy field servicing.
   3. The compressor motor shall be accessible for servicing without removing the compressor base from the chiller. Connections to the compressor casing shall use O-rings and gaskets to reduce the occurrence of refrigerant leakage. Connections to the compressor shall be flanged or bolted for easy disassembly.
   4. Compressor bearings must have individual design life of 50 years or greater when operating at AHRI conditions.
   5. Compressor shall provide capacity modulation from 100% to 15% capacity without the use of hot gas bypass or mechanical unloaders.
   6. Compressor shall be provided with a factory-installed positive pressure lubrication system to deliver oil under pressure to bearings and rotors at all operating conditions. Lubrication system shall include:
      a. Oil pump with factory-installed motor contactor with overload protection.
      b. Oil pressure sensor with differential readout at main control center.
      c. Oil pressure regulator.
      d. Oil filter with isolation valves to allow filter change without removal of refrigerant charge.
      e. Oil sump heater [115 v, 50 or 60 Hz] controlled from unit microprocessor.
      f. Oil reservoir temperature sensor with main control center digital readout.
      g. All wiring to oil pump, oil heater, and controls shall be pre-wired in the factory and power shall be applied to check proper operation prior to shipment.

7. Compressor shall be fully field serviceable. Compressors that must be removed and returned to the factory for service shall be unacceptable.
8. Acoustical attenuation shall be provided as required, to achieve a maximum (full load) sound level, measured per AHRI Standard 575 (latest edition).

C. Motor:
1. Compressor motor shall be of the semi-hermetic, liquid-refrigerant-cooled, squirrel-cage, induction-type suitable for voltage shown on the equipment schedule.
2. If an open (air-cooled) motor is provided, a compressor shaft seal leakage containment system shall be provided:
   a. An oil reservoir shall collect oil and refrigerant that leaks past the seal.
   b. A float device shall be provided to open when the reservoir is full, directing the refrigerant/oil mixture back into the compressor housing.
   c. A refrigerant sensor shall be located next to the open drive seal to detect leaks.
3. Motors shall be suitable for operation in a refrigerant atmosphere and shall be cooled by atomized refrigerant in contact with the motor windings.
4. Motor stator shall be arranged for service or removal with only minor compressor disassembly and without removing main refrigerant piping connections.
5. Full load operation of the motor shall not exceed nameplate rating.
6. One motor winding temperature sensor (and one spare) shall be provided.

D. Evaporator and Condenser:
1. Evaporator and condenser shall be of shell and tube type construction, each in separate shells. Units shall be fabricated with high-performance tubing, steel shell and tube sheets with waterboxes. Waterboxes shall be nozzle-in-head type with stub out nozzles having Victaulic grooves to allow for use of Victaulic couplings.
2. Tubing shall be copper, high-efficiency type, with integral internal and external enhancement unless otherwise noted. Tubes shall be nominal 3/4-in. outside diameter (OD) with nominal wall thickness of 0.025 in. measured at the root of the fin unless otherwise noted. Tubes shall be rolled into tube sheets and shall be individually replaceable. Tube sheet holes shall be double grooved for joint structural integrity. Intermediate support sheet spacing shall not exceed 36 in. (914 mm).
3. Waterboxes and nozzle connections shall be designed for 150 psig (1034 kPa) minimum working pressure unless otherwise noted. Nozzles should have grooves to allow use of Victaulic couplings.
4. The tube sheets of the evaporator and condenser shall be bolted together to allow for field disassembly and reassembly.
5. The vessel shall display an ASME nameplate that shows the pressure and temperature data and the ‘U’ stamp for ASME Section VIII, Division 1. A re-seating pressure relief valve(s) shall be installed on each heat exchanger. If a non-reseating type is used, a backup reseating type shall be installed in series.
6. Waterboxes shall have vents, drains, and covers to permit tube cleaning within the space shown on the drawings. A thermistor-type temperature sensor with quick connects shall be factory installed in each water nozzle.
7. Evaporator shall be designed to prevent liquid refrigerant from entering the compressor. Devices that introduce pressure losses (such as mist eliminators) shall not be acceptable because they are subject to structural failures that can result in extensive compressor damage.
8. Tubes shall be individually replaceable from either end of the heat exchanger without affecting the strength and durability of the tube sheet and without causing leakage in adjacent tubes.
9. The subcooler, located in the bottom of the condenser, shall increase the refrigeration effect by cooling the condensed liquid refrigerant to a lower temperature, thereby reducing compressor power consumption.

E. Refrigerant Flow Control: The variable flow control system regulates refrigerant flow according to load conditions, providing a liquid seal at all operating conditions, eliminating unintentional hot gas bypass.

F. Automatic Hot Gas Bypass: Hot gas bypass valve and piping shall be factory-furnished to permit chiller operation for extended periods of time.

G. Controls, Safeties, and Diagnostics:
1. Controls:
a. The chiller shall be provided with a factory-installed and factory-wired microprocessor control center. The microprocessor can be configured for either English or SI units.
b. All chiller and starter monitoring shall be displayed at the chiller control panel.
c. The controls shall make use of non-volatile memory.
d. The chiller control system shall have the ability to interface and communicate directly to the building control system.
e. The default standard display screen shall simultaneously indicate the following minimum information:
1) date and time of day
2) 24-character primary system status message
3) 24-character secondary status message
4) chiller operating hours
5) entering chilled water temperature
6) leaving chilled water temperature
7) evaporator refrigerant temperature
8) entering condenser water temperature
9) leaving condenser water temperature
10) condenser refrigerant temperature
11) oil supply pressure
12) oil sump temperature
13) percent motor rated load amps (RLA)
f. In addition to the default screen, status screens shall be accessible to view the status of every point monitored by the control center including:
1) evaporator pressure
2) condenser pressure
3) bearing oil supply temperature
4) compressor discharge temperature
5) motor winding temperature
6) number of compressor starts
7) control point settings
8) discrete output status of various devices
9) compressor motor starter status
10) optional spare input channels
11) current and voltage for each phase
12) frequency
g. Schedule Function: The chiller controls shall be configurable for manual or automatic start-up and shutdown. In automatic operation mode, the controls shall be capable of automatically starting and stopping the chiller according to a stored user programmable occupancy schedule. The controls shall include built-in provisions for accepting:
1) A minimum of two 365-day occupancy schedules.
2) Minimum of 8 separate occupied/unoccupied periods per day.
3) Daylight savings start/end.
4) Minimum of 18 user-defined holidays.
5) Means of configuring an occupancy timed override.

6) Chiller start-up and shutdown via remote contact closure.

h. Service Function: The controls shall provide a password protected service function which allows authorized individuals to view an alarm history file which shall contain the last 25 alarm/alert messages with time and date stamp. These messages shall be displayed in text form, not codes.

i. Network Window Function: Each chiller control panel shall be capable of viewing multiple point values and statuses from other like controllers connected on a common network, including controller maintenance data. The operator shall be able to alter the remote controller's set points or time schedule and to force point values or statuses for those points that are operator forcible. The control panel shall also have access to the alarm history file of all like controllers connected on the network.

j. Pump Control: Upon request to start the compressor, the control system shall start the chilled water pump, condenser water pumps and verify that flows have been established.

k. Ramp Loading: A user-configurable ramp loading rate, effective during the chilled water temperature pulldown period, shall control the rate of guide vane opening to prevent a rapid increase in compressor power consumption. The controls shall allow configuration of the ramp loading rate in either degreesminute of chilled water temperature pulldown or percent motor amps/minute. During the ramp loading period, a message shall be displayed informing the operator that the chiller is operating in ramp loading mode.

l. Chilled Water Reset: The control center shall allow reset of the chilled water temperature set point based on any one of the following criteria:
   1) Chilled water reset based on an external 4 to 20 mA signal.
   2) Chilled water reset based on a remote temperature sensor (such as outdoor air).
   3) Chilled water reset based on water temperature rise across the evaporator.

m. Demand Limit: The control center shall limit amp draw of the compressor to the rated load amps or to a lower value based on one of the following criteria:
   1) Demand limit based on a user input ranging from 40% to 100% of compressor rated load amps.
   2) Demand limit based on external 4 to 20 mA signal.

n. Controlled Compressor Shutdown: The controls shall be capable of being configured to soft stop the compressor. When the stop button is pressed or remote contacts open with this feature active, the guide vanes shall close to a configured amperage level and the machine shall then shut down. The display shall indicate "shutdown in progress."

o. BACnet™[1] Communication: Allows integration with i-Vu® Open control system or a BACnet building automation system.

2. Safeties:
   a. Unit shall automatically shut down when any of the following conditions occur (each of these protective limits shall require manual reset and cause an alarm message to be displayed on the control panel screen, informing the operator of the shutdown cause):
      1) Motor overcurrent

[1]Third-party trademarks and logos are the property of their respective owners.

2) Over voltage[2]
3) Under voltage**Error! Reference source not found.**
4) Single cycle dropout**Error! Reference source not found.** (LF-2 VFDs only)
5) Low oil sump temperature
6) Low evaporator refrigerant temperature
7) High condenser pressure
8) High motor temperature
9) High compressor discharge temperature
10) Low oil pressure
11) Prolonged stall
12) Loss of evaporator water flow
13) Loss of condenser water flow
14) Variable frequency drive fault
15) High variable frequency drive temperature

b. The control system shall detect conditions that approach protective limits and take self-corrective action prior to an alarm occurring. The system shall automatically reduce chiller capacity when any of the following parameters are outside their normal operating range:
1) High condenser pressure
2) High motor temperature
3) Low evaporator refrigerant temperature
4) High motor amps
5) High VFD inverter temperature

c. During the capacity override period, a pre-alarm (alert) message shall be displayed, informing the operator which condition is causing the capacity override. Once the condition is again within acceptable limits, the override condition shall be terminated and the chiller shall revert to normal chilled water control. If during either condition the protective limit is reached, the chiller shall shut down and a message shall be displayed informing the operator which condition caused the shutdown and alarm.

d. Internal built-in safeties shall protect the chiller from loss of water flow. Differential pressure switches shall not be allowed to be the only form of freeze protection.

3. Diagnostics and Service:
a. A self-diagnostic controls test shall be an integral part of the control system to allow quick identification of malfunctioning components.

b. Once the controls test has been initiated, all pressure and temperature sensors shall be checked to ensure they are within normal operating range. A pump test shall automatically energize the chilled water pump, condenser water pump, and oil pump. The control system shall confirm that water flow and oil pressure have been established and require operator confirmation before proceeding to the next test.

c. In addition to the automated controls test, the controls shall provide a manual test, which permits selection and testing of individual control components and inputs. A thermistor test and transducer test shall display on the PIC6 screen the actual reading of each transducer and each thermistor installed on the chiller. All out-of-range sensors shall be identified. Pressure transducers shall be serviceable without the need for refrigerant charge removal or isolation.

H. Electrical Requirements:
1. Electrical contractor shall supply and install main electrical power line, disconnect switches, circuit breakers, and electrical protection devices per local code require-

[2]Shall not require manual reset or cause an alarm if auto-restart after power failure is enabled.

ments and as indicated necessary by the chiller manufacturer.

2. Electrical contractor shall wire the chilled water pump and flow, condenser water pump and flow, and tower fan control circuit to the chiller control circuit.
3. Electrical contractor shall supply and install electrical wiring and devices required to interface the chiller controls with the building control system if applicable.
4. Electrical power shall be supplied to the unit at the voltage, phase, and frequency listed in the equipment schedule.

I. Piping Requirements — Instrumentation and Safeties:

1. Mechanical contractor shall supply and install pressure gauges in readily accessible locations in piping adjacent to the chiller such that they can be easily read from a standing position on the floor. Scale range shall be such that design values shall be indicated at approximately mid-scale.
2. Gauges shall be installed in the entering and leaving water lines of the evaporator and condenser.

J. Vibration Isolation: Chiller manufacturer shall furnish neoprene isolator pads for mounting equipment on a level concrete surface.

K. Start-Up:

1. The chiller manufacturer shall provide a factory-trained representative, employed by the chiller manufacturer, to perform the start-up procedures as outlined in the Start-Up, Operation and Maintenance manual provided by the chiller manufacturer.
2. Manufacturer shall supply the following literature:
   a. Start-up, operation and maintenance instructions.
   b. Installation instructions.
   c. Field wiring diagrams.
   d. One complete set of certified drawings.

L. Special Features:

1. Refrigerant Charge: The chiller shall ship from the factory fully charged with HFC/HFO-513A refrigerant and oil.
2. Thermal Insulation: Unit manufacturer shall insulate the evaporator shell, economizer, suction elbow, motor shell, and motor cooling lines. Insulation shall be 1 in. (25.4 mm) thick with a thermal conductivity not exceeding

$$0.28 \ \frac{(\text{Btu} \cdot \text{in.})}{\text{hr. Ft}^2\ \text{F}} \ \left(0.0404 \ \frac{\text{W}}{\text{m C}} \right)$$

   and shall conform to UL standard 94, classification 94 HF-1.
3. Evaporator and Condenser Tubes: Contact your local Carrier Representative for other tube offerings.
4. Evaporator and Condenser Passes: Unit manufacturer shall provide the evaporator and/or condenser with 2-pass configurations on the water side.
5. Compressor Discharge Isolation Valve and Liquid Line Ball Valve: These items shall be factory installed to allow isolation of the refrigerant charge in the condenser for servicing the compressor.
6. Unit-Mounted Variable Frequency Drive (VFD):
   a. Design:
      1) VFD shall be air or refrigerant cooled, microprocessor-based, pulse width modulated design. Water-cooled designs are not acceptable.
      2) Output power devices shall be insulated gate bipolar transistors (IGBTs).
      3) Converter section with full-wave fixed diode bridge rectifier shall convert
      4) incoming fixed voltage/frequency to fixed DC voltage.

5) DC link shall filter and smooth the converted DC voltage.
6) Transistorized inverter and control regulator shall convert fixed DC voltage to a sinusoidal PWM waveform.
7) Integrated controls shall coordinate the motor speed to optimize chiller performance over a wide variety of operating conditions.

b. Enclosure:
1) Pre-painted, unit-mounted NEMA 1 cabinet shall include hinged, lockable doors and removable lifting lugs.
2) VFD shall have a short circuit current rating of at least 65,000 amps (100,000 amps is optional).
3) Provisions to padlock main disconnect handle in the “Off” positions shall be provided. Mechanical interlock to prevent opening cabinet door with disconnect in the “On” position or moving disconnect to the “ON” position while the door is open shall be provided.
4) Provisions shall be made for top entry of incoming line power cables.

c. Heat Sink:
1) The heat sink (frame sizes 3, 4, 5 heat exchangers only) shall be refrigerant cooled. Heat sink and mating flanges shall be suitable for ASME design working pressure of 185 psig (1276 kPa).
2) Refrigerant cooling shall be metered by integrated standard controls to maintain heat sink temperature within acceptable limits for ambient temperature.

d. VFD Rating:
1) Drive shall be suitable for nameplate voltage ±10%.
2) Drive shall be suitable for continuous operation at 100% of nameplate amps and 150% of nameplate amps for 3 seconds.
3) Drive shall comply with applicable UL, CE, and NEMA standards.
4) Drive shall be suitable for operation in ambient temperatures between 40 and 104 F (4.4 and 40 C), 95% humidity (non-condensing) for altitudes up to 3300 ft (1006 m) above sea level. Specific drive performance at jobsite ambient temperature and elevation shall be provided by the manufacturer in the bid.

e. User Interface: Displays shall provide interface for programming and display of VFD and chiller parameters. Viewable parameters include:
1) Operating, configuration and fault messages
2) Frequency in Hz
3) Load side voltage and current (at the VFD)
4) kW (on the VFD interface)

f. VFD Performance:
1) VFD full load efficiency shall meet or exceed 97% at 100% VFD Rated Ampacity.
2) Base motor frequency shall be either 50 or 60 Hz.

g. VFD Electrical Service (single point power):
1) VFD shall have input circuit breaker with minimum 65,000 amp interrupt capacity.
2) VFD shall have standard 15 amp branch oil pump circuit breaker to provide power for chiller oil pump.
3) VFD shall have standard 4 KVA control power transformer with circuit breaker to provide power for oil heater, VFD controls, and chiller controls.
4) The branch oil pump circuit breaker and control power transformer shall be factory wired.
5) Input power shall be 380/480 vac, ±10 percent, 3 phase, 50/60 Hz, ±3 Hz.

h. Discrete Outputs: 115-v discrete contact outputs shall be provided for:

1) Chilled water pump
2) Condenser water pump
3) Alarm status.

i. Analog Output: An analog (4 to 20 mA) output for head pressure reference shall be provided. This signal shall be suitable to control a 2-way or 3-way water regulating valve in the condenser piping.

j. Protection (the following shall be supplied):
1) Under-voltage
2) Over voltage
3) Phase loss
4) Phase unbalance protection
5) Programmable auto re-start after loss of power
6) Motor overload protection (NEMA Class 10)
7) Motor over temperature protection

k. VFD Testing: The VFD shall be factory mounted, wired, and tested on the chiller prior to shipment.

END OF SECTION 23 61 10

SECTION 23 65 00 - INDUCED DRAFT COOLING TOWER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cooling Tower package.

B. Controls and control connections.

C. Condenser water connections.

E. Domestic Water makeup.

F. Starters.

G. Electrical power connections.

1.2 RELATED SECTIONS

A. Section 23 21 13 - Hydronic Piping.

B. Section 23 21 16 - Hydronic Specialties.

1.3 REFERENCES

A. ANSI/ASHRAE STANDARD 15-1992 - Safety Code for Mechanical refrigeration.

B. ANSI/ASHRAE 90.1 - Energy Efficient Design of New Buildings.

C. ANSI/ASME SEC VIII - Boiler and Pressure Vessel Code.

D. ANSI/ASME B31.S-1983 ASME Code for Pressure Piping and Refrigeration Piping.

E. ANSI/UL 1995 - Central Cooling Air Conditioners.

F. CTI – Cooling Tower Institute.

G. ANSI/ARI 550/590-98 - Standard for Water Chilling Packages using the Vapor Compression Cycle.

H. ARI STANDARD 575-87 - Method of Measuring Machinery Sound Within Equipment Rooms.

1.4 SUBMITTALS

A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

B. Submit product data indicating rated capacities, full load and part load performance, weights, specialties and accessories, electrical requirements and wiring diagrams.

C. Submit manufacturer's installation instructions.

1.5 OPERATION AND MAINTENANCE DATA

A. Include start-up instructions, operation data, maintenance data, controls, and accessories. Include trouble-shooting guide.

1.6 VERIFICATION OF CAPACITY AND EFFICIENCY

A. All proposals for cooling tower performance must include a CTI approved selection method. Verification of date and version of computer program selection or catalog is available through the Vice President, Engineering, CTI.

1.7 REGULATORY REQUIREMENTS

A. Conform to ARI Standard 550/590-98 for rating and certified testing.

B. Conform to ANSI/UL 1995 - Standard for Heating and Cooling Equipment, Safety Standard .

C. Conform to CTI Standards

D. Conform to ANSI/ASHRAE STANDARD 15-1992 safety code for mechanical refrigeration.

1.8 HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.9 WARRANTY

A. Manufacturer shall provide a 5-year parts warranty.

B. Manufacturer shall provide whole unit labor warranty for the duration of 5 year.

1.10 MAINTENANCE SERVICE

A. Preventive maintenance procedures must be adhered to, including required periodic inspections as prescribed in the manufacturers published operation and maintenance literature. Records of these procedures and inspections must be retained.

PART 2 PRODUCT

2.1 COOLING TOWER

A. General: Furnish and install two (2) factory-assembled, induced draft, crossflow cooling tower(s) with vertical air discharge conforming in all aspects to the specifications, schedules and as shown on the plans. Cooling towers shall be as manufactured by Baltimore Aircoil Company or Marley.

B. Thermal Capacity: The cooling tower(s) shall be warranted by the manufacturer to cool the required gpm of water in accordance with the cooling tower schedule. Additionally, the thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Lacking such certification, a field acceptance test shall be conducted within the warranty period in accordance with CTI Acceptance Test Code ATC-105, by the Cooling Technology Institute or other qualified independent third party testing agency. A manufacturer’s performance guarantee or performance bond without CTI Certification or independent field thermal performance test shall not be accepted. The cooling tower shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.

C. Corrosion Resistant Stainless Steel Construction: All steel panels and structural members, including the casing panels, hot and cold water basins, distribution covers, fan deck and fan cylinder shall be constructed of Type 304 stainless steel and assembled with Type 304 stainless steel nut and bolt fasteners. All factory seams in the cold water basin shall be welded to ensure watertight assembly and shall be unconditionally warranted against leaks for five (5) years from substantial completion. Bolted stainless steel basins will not be acceptable.

D. Quality Assurance:The cooling tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO-9001 to ensure consistent quality of products and services. Cooling tower manufacturers that are not ISO-9001:2000 certified shall provide an additional year of warranty to the customer at no additional cost.

2.2 CONSTRUCTION DETAILS

A. Cold Water Basin: The cold water basin shall be constructed of heavy-gauge Type 304 stainless steel panels and structural members. The basin shall include a depressed section with drain/clean-out connection. The basin area under the wet deck surface shall be sloped toward the depressed section to facilitate cleaning. Standard basin accessories shall include a brass make-up valve with large diameter plastic float for easy adjustment of the operating water level. All factory seams in the cold water basin shall be welded to ensure water-tight assembly and be unconditionally warranted against leaks for five (5) years from Substantial Completion. Bolted stainless steel basins will not be acceptable.

B. Water Outlet: The cooling tower basin outlet shall be beveled for welding and grooved for mechanical coupling or a bolt hole circle to accept an ASME Class 150 flat face flange. The outlet shall be provided with large area lift out strainers with perforated openings sized smaller than the water distribution nozzles and an anti-vortexing device to prevent air entrainment. The strainer and vortex device shall be constructed of the same materials as the cold water basin to prevent dissimilar metal corrosion.

C. Water Distribution System: The distribution system shall be furnished with a single water inlet. The pipe stub connection shall be beveled for welding and grooved for mechanical coupling. The hot water distribution basin shall be open gravity type and constructed of heavy-gauge 304 stainless steel. Plastic metering devices shall be provided to ensure the uniform distribution of water over the wet deck surface. Lift-off distribution covers shall be constructed of heavy gauge 304 stainless steel.

2.3 MECHANICAL EQUIPMENT

A. Fan(s): Fan(s) shall be axial flow with aluminum alloy blades selected to provide optimum cooling tower thermal performance with minimal sound levels. Air shall discharge through a fan cylinder designed for streamlined air entry and minimum tip clearance for maximum fan efficiency. The top of the fan cylinder shall be equipped with a conical, non-sagging removable fan guard.

B. Bearings: Fan(s) and shaft(s) shall be supported by heavy-duty, self-aligning, grease packed ball bearings with moisture proof seals and integral slinger collars, designed for a minimum L10 life of 40,000 hours (280,000 Hr. Avg. Life).

C. Fan Drive: The fan(s) shall be driven by a one-piece, multi-groove, solid back V-type powerband with taper lock sheaves designed for 150% of the motor nameplate horsepower. The powerband shall be constructed of neoprene reinforced polyester cord and be specifically designed for cooling tower service.

D. Sheaves: Fan and motor sheave(s) shall be fabricated from corrosion-resistant materials to minimize maintenance and ensure maximum drive and powerband operating life.

E. Fan Motor: Fan motor(s) shall be totally enclosed air over (TEAO), reversible, squirrel cage, ball bearing type designed specifically for cooling tower service. The motor shall be furnished with special moisture protection on winding, shafts, and bearings. Fan motors shall be inverter duty type designed per NEMA Standard MG1, Section IV Part 31.

F. Mechanical Equipment Warranty: The fan(s), fan shaft(s), bearings, mechanical equipment support, and fan motor shall be warranted against defects in materials and workmanship for a period of five (5) years from substantial completion.

2.4 WET DECK SURFACE AND DRIFT ELIMINATORS

A. Wet Deck Surface and Drift Eliminators: The wet deck surface and integral drift eliminators shall be formed from self-extinguishing (per UL94 HB and UL94 V-0 testing) polyvinyl chloride (PVC) having a flame spread rating of 5 per ASTM E84 and shall be impervious to rot, decay, fungus and biological attack. The wet deck surface shall be manufactured, tested, and rated by the cooling tower manufacturer and shall be elevated above the cold water basin to facilitate cleaning.

2.5 AIR INLET LOUVERS

A. Air Inlet Louvers: Air inlet louvers shall prevent water splash-out during fan cycling and be constructed of maintenance free, corrosion resistant, UV protected, fiberglass reinforced polyester (FRP) or PVC.

2.6 ACCESS

A. Plenum Access: Hinged access doors shall be provided on two sides of the tower for access into plenum section. Additionally, an external service platform constructed of galvanized steel shall be provided on the air inlet side of the cooling tower complete with handrails, aluminum ladder and safety cage per OSHA standards.

2.7 ACCESSORIES

A. Additional accessories which are to be provided with the cooling tower include:
   1. Mechanical vibration cutout switch with local reset
   2. Electric pan heater with electric heating elements, low level cutout, thermostat, and NEMA rated control panel housing contactors for the heating elements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service.

C. Furnish and install necessary auxiliary sump heater.

D. Arrange piping for easy tower cleaning.

END SECTION 23 65 00

SECTION 23 70 00 - CENTRAL STATION AIR HANDLER

PART 1 GENERAL

1.1 WORK INCLUDED

A. Applied Air Handling Units.

1.2 RELATED SECTIONS

A. Section 23 05 16 - Expansion Compensation.

1.3 REFERENCES

A. AMCA 300 - Reverberant Method for Sound Testing of Fans.

B. AMCA 301 - Method for Publishing Sound Ratings for Air Moving Devices.

C. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

D. ANSI/UL 900 - Test Performance of Air Filter Units.

E. ARI 260 - Standard for Sound Rating of Ducted Air Moving and Conditioning Equipment

F. ARI 410 - Standard for Forced Circulation Air-Cooling and Air-Heating Coils.

G. ARI 430 - Standard for Central Station Air Handling Units.

H. ARI 1060 Air-To-Air Energy Recovery Ventilation Equipment

I. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.

J. ASTMB 117 - Standard Practice for Operation Salt Spray Apparatus

K. NEMA MG1 - Motors and Generators

L. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.

M. SMACNA - HVAC Duct Construction Standards.

N. UL 1995 - Heating and Cooling Equipment

1.4 QUALITY ASSURANCE

A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current ARI 410 Standard.

B. Certify air-handling units in accordance with ARI 430.

C. ISO 9001 Certification.

1.5 SUBMITTALS

A. Submit unit performance including: capacity, nominal and operating performance.

B. Submit Mechanical Specifications for unit and accessories describing construction,

components and options.

C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations. Indicate unit shipping split locations, and split dimensions, installation and operating weights including dimensions.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit data on electrical requirements. Include safety and start-up instructions.

F. Submit sound data certified to ARI 260.

1.6 REGULATORY REQUIREMENTS

A. Unit shall be manufactured to conform to UL 1995 Standard and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to unit. In the event the unit is not UL/CUL or ETL approved, the contractor shall, at his/her expense provide for a field inspection by a UL/CUL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the owner.

B. Certify air-handling units in accordance with ARI 430. If air-handling units are not certified in accordance with ARI 430, contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.

C. Certify air-handling coils in accordance with ARI 410. If air-handling coils are not certified in accordance with ARI 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs or shipping skid to allow for field rigging and final placement of section.

C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.

D. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 START-UP AND OPERATING REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torque, and fan has been test run under observation.

1.9 WARRANTY

A. The equipment manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of five year from substantial completion, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers not pre-approved, must obtain pre-approval in writing from consulting engineer prior to bid day. Alternates must comply with all performance and features as called for in this specification.

B. Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to consulting engineer prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the consulting engineer. Mechanical Contractor is responsible for expenses that occur due to exceptions made.

C. Approved Manufacturers:
1. Trane
2. York
3. McQuay Vision

2.2 GENERAL

A. Unit layout and configuration shall be as defined in project plans and schedule.

B. Provide factory-installed external support kit (minimum height of 6”) on the base of the unit. External support kit shall be used for ceiling suspension, external isolation, or with housekeeping pad. Contractor will be responsible for providing a housekeeping pad when unit mounting device is not of sufficient height to properly trap unit. Unit mounting devices not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel.

2.3 UNIT CASING

A. Unit shall be constructed of a complete structural frame with removable panels. Unit manufacturer shall ship separate segments so unit can be broken down for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel with the exception of in panel. Inside panel shall be stainless steel. Casing finished to meet ASTMB 117 250-hour salt-spray test. The removal of side panels shall not affect the structural integrity of the unit. All removable panels shall be gasketed to minimize air leakage. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Construct casing sections capable of operating from -4"wg to +6"wg .

C. Access panels and/or access doors shall be available on both sides of the unit in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance. If panels are not removable, then manufacturer shall provide access sections with doors between all internal components to ensure access and clean ability of the air handler.

D. Access doors shall be double wall construction to prevent damage to insulation during routine maintenance.

E. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of all interior surfaces.

F. Door hardware shall be surface mounted to minimize penetrations in the door casing that could lead to air leakage paths. All access door hinges shall be constructed of metal. Plastic or rubber hinges are not acceptable.

G. All joints between exterior panels and structural frames, as well as joints between module frames, shall be properly sealed and gasketed to provide an air seal.

H. Insulation - High density - Insulation shall be encased in double-wall casing between exterior and interior solid panel such that no insulation can erode to the airstreams. Foil facing on insulation is not an acceptable alternate to double wall construction. Insulation shall have a minimum R-Value of 8 and shall be UL listed. Minimum insulation thickness shall be 2 inches. The installation shall comply with NFPA-90A and B requirements.

2.4 FANS

A. Provide fans of type and class as specified on the schedule. Fan shafts shall be solid, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans controlled by variable frequency drives shall be statically and dynamically tested for vibration and alignment at speeds between 25% and 100% of design RPM. If fans are not factory-tested for vibration and alignment, the contractor shall be responsible for cost and labor associated with field balancing and certified vibration performance. Fan wheels shall be keyed to fan shafts to prevent slipping.

B. Provide grease lubricated ball bearings selected for L-50 200,000-hour average life per ANSI/AFBMA 9. Greasable bearings shall have lubrication lines extended to the drive side of the unit. Lubrication lines shall be a clear, high-pressure, polymer to aid in visual inspection. Extend both grease lubrication lines to drive side of unit and rigidly attach to drive side bearing support with zerk fittings. If extended lubrication lines are not provided, manufacturer shall provide permanently lubricated bearing with engineering calculations for proof of bearing life.

C. Fans shall be mounted on isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with spring isolators. Flexible canvas ducts shall be installed between fan and unit casing to ensure complete isolation. Flexible canvas ducts shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

D. Fan modules shall have a minimum of one access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components. Construct door(s) per Section 2.03 paragraphs D, E, and F.

E. Belts shall be enclosed as required by OSHA standard 29 CFR 1910 to protect worker from accidental contact with the belts and sheaves.

2.5 MOTORS AND DRIVES

A. All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor

change in the future, should airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the contractor. The contractor shall be responsible for all costs associated with installation of motor and drive, alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.

B. Fan Motors shall be heavy duty, open drip-proof (ODP) high efficiency, operable at specified voltage.

C. Motors shall be selected to operate continuously at 104 F (40 C) ambient without tripping of overloads. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation. Motors shall be in compliance with EPACT when applicable.

D. V-Belt Drive shall be constant pitch rated at 1.5 times the motor nameplate.

E. Manufacturer shall provide for each fan a nameplate with the following information to assist air balance contractor in start up and service personnel in maintenance:
   1. Fan and motor sheave part number
   2. Fan and motor bushing part number
   3. Number of belts and belt part numbers
   4. Fan design RPM and motor HP
   5. Belt tension and deflection
   6. Center distance between shafts

2.6 COILS

A. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drainpan under the coil.

B. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

C. Construct coil casings of stainless steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

D. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

E. On stacked cooling coils, intermediate drain pans shall be installed between the coils. Intermediate drain pans shall have drop tubes to guide condensate to the main drain pan, thus preventing flooding of lower coils that would result in moisture carryover.

F. Hydronic Coils
   1. Supply and return header connections shall be clearly labeled on outside of units such that direction of coil water-flow is counter to direction of unit air-flow.
   2. Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure under water.
   3. Headers shall be constructed of round copper pipe or cast iron.
   4. Tubes shall be 1/2 inch O.D. minimum 0.016 inch thick copper. Fins shall be aluminum. Construction and spaced at a maximum of 11 fins per inch.

5. Coated with herisite coating.

2.7 BASE-LEVEL DRAIN PANS

A. Drain pans shall be constructed of stainless steel. Insulation shall be encased between exterior and interior walls. Units with cooling coils shall have drain pans under complete cooling coil section that extend beyond the air-leaving side of the coil to ensure capture of all condensate in section. Cooling coil drain pans shall be sloped in 2 planes, pitched toward drain connections to ensure complete condensate drainage when unit is installed level and trapped per manufacturer's requirements. See section 2.05, paragraph E for specifications on intermediate drain pans between cooling coils.

B. Units with heating coils shall have a drain pan under complete heating coil section sloped in 2 planes and pitched toward drain connections to ensure proper drainage during cleaning and to capture water in the event of a coil failure.

C. All drain pan connections supplied by unit manufacturer including, piping, and piping connections extending from stainless steel drain pans shall be constructed of stainless steel. The contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

2.8 FILTERS

A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.03, paragraphs D, E, and F. Provide filter block offs as required to prevent air bypass around filters.

B. Filter type, efficiency, and arrangement shall be provided as defined in project plans and schedule. Filters shall be removable from one side of filter section(s). Filters shall be 30% pleated media type.

C. Manufacturer shall provide one set of startup filters.

2.9 DAMPERS

A. All dampers, with the exception of external bypass and multi-zones (if scheduled), shall be internally mounted. Dampers shall be premium ultra low leak and located as scheduled. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 5 CFM/square foot at one inch water gauge and 9 CFM/square foot at 4 inches water gauge. All leakage testing and pressure ratings shall be based on AMCA Publication 500. Manufacturer shall submit brand and model of damper(s) being furnished.

END OF SECTION 23 70 00

SECTION 23 84 19 - POOL DEHUMIDIFICATION UNITS

PART 1 GENERAL

1.1 UNIT DESCRIPTION

A. Enclosure: The unit shall be fabricated per the following method: The base shall be U.S. 12 gauge Galvanneal steel; corner posts and side posts shall be formed U.S. 18 gauge Galvanneal steel; top panels and removable side panels shall be a minimum of U.S. 18 gauge Galvanneal steel. Removable panels shall be provided to allow easy access to all internal parts and components. The electrical control box and switch panel shall be enclosed in a separate compartment, complete with a hinged door.

B. Paint and Finish: Prior to painting, all metal parts shall be pretreated to remove oils and dirt and rinsed with an ionized solution. Painting shall be by a powder coat technique to assure positive adherence with a high impact finish. All sides of panels shall be painted after manufacturing. The paint shall be High Yield Polyester. The paint shall be rated to meet a minimum of 1,000-hour salt spray test (ASTM B117), have a minimum Direct Impact Resistance of 160 in-lbs (ASTM D2794), have a minimum flexibility of ¼" Mandrel (ASTM D522, Method B) and a minimum 1000-hour Humidity Resistance (ASTM D2247). The unit color shall be light gray.

1.2 REFRIGERATION SYSTEM:

A. Refrigerant: The system's operating refrigerant shall be R-454B.

B. Compressors: The compressor shall be a heavy-duty, scroll, hermetic compressor. The compressor shall be equipped with low and high pressure safety devices, with internal protection from overheating. The compressor shall be externally vibration isolated. Units 10-ton and above shall be equipped with suction line accumulators.

C. Receiver: The unit shall include a refrigerant receiver. The receiver shall assist the unit in operating at the highest efficiency over a wide range of load conditions.

D. The unit shall include hot gas bypass for each system compressor set.

1.3 EVAPORATOR DEHUMIDIFIER COILS:

A. Fins: Fins shall be die-formed, aluminum and shall be damage resistant. Extruded fin collars provide maximum heat transfer. Fin spacing shall be 12 FPI (fins per inch) maximum. The coil shall be a maximum of 30" in height to avoid water carryover to the reheat coil and re-evaporation into the air stream.

B. Tubes: Coils shall be fabricated from seamless drawn copper. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability.

C. Each coil shall have its own drain pan.

D. Testing: Coils shall be leak tested with nitrogen.

E. Evaporator Bypass: Provide a bypass damper to bypass a portion of the return air stream. After the evaporator has dehumidified its portion of the air stream, the mixing of the bypass and evaporator air shall result in a temperature above the space dew point temperature.

F. Refrigerant Condenser Coils:

G. Air-Cooled Condenser (Reheat Coil):

H. The reheat coil shall be positioned with a minimum of 5” clearance from the DX coil to help prevent water re-evaporation.

I. Fins: Fins shall be die–formed aluminum and shall be damage resistant. Fin spacing shall be 10 to12 FPI (fins per inch) maximum.

J. Tubes: Coils shall be fabricated from seamless drawn copper. The tubes shall be hydraulically expanded into the fins to form a permanent metal–to–metal bond for maximum heat transfer and stability.

K. Testing: Coils shall be leak tested with nitrogen.

1.4 COIL COATING

A. All air-side refrigerant heat exchangers (coils) shall be coated with a corrosion inhibitor (coating). The coating shall be applied after the coil is assembled and shall cover fins, exposed tubes, headers, and sheet metal casing. The application process shall achieve full penetration of the coil, so the fins are entirely coated, and shall be wear resistant and shall have negligible impact on heat transfer or airflow (no pooling or bridging). Using coated fin stock is not an acceptable alternative, because it leaves bare edges in the airstream, and does not coat tube or sheet metal parts. The following standards shall be met or exceeded:
   1. Dry film thickness of 0.6-1.2 mils per ASTM D7091, or heat transfer reduction less than 3%
   2. 5B rating for cross-hatch adhesion per ASTM B3359
   3. 15,000 hours of salt spray per ASTM B117, or 6,000 hours per ASTM G85 A3
   4. Temperature range –40°F to 250°F
   5. Warranted to be free of defects in materials and workmanship for five (5) years
   6. REACH and RoHS compliant.

1.5 REMOTE AIR-COOLED CONDENSER:

A. The size and capacity shall be in accordance with the unit schedule. The system shall be able to reject all the recovered heat (T.H.R.) from the unit to the outdoor condenser.

B. The RCD series units shall be provided with a weatherproof electrical panel. A field supplied and installed disconnect is required per the local code requirements.

C. The cabinet shall be constructed of powder coated galvannealed steel. The unit shall be provided with lifting brackets in each corner support.

D. The coil shall be constructed of copper tubing in a staggered design. Tubes shall be hydraulically expanded into full-collared, plate-type aluminum fins. Coils shall be factory leak-tested and sealed with caps.

E. The fan motors shall be Electronically Commutated (EC) design for maximum efficiency. All motors shall be factory-wired with leads terminating in the control panel.

F. The fan motor and fan shall be manufactured and supplied to the equipment manufacturer as a single unit.

G. For maximum system efficiency, the fan speed shall be modulated to maintain the internal pressure head to a preset, and adjustable, set point.

H. Fan guards shall be heavy-gauge, closed-mesh steel wire. Guards shall be contoured for maximum rigidity.

I. The condenser will produce a maximum of 69dbA @ 3 meters in accordance with AHRI standard 370-2001. On non-design condition days, the modulated fan will run slower and the

noise will be lower.

1.6 AUXILIARY HEATER

A. Electric Heater:
1. The capacity shall be in accordance with the schedule. The heater shall be integral to the unit and wired to the units as a single-point power connection or separate power for the electric heater. The option is configured at the factory at the time of manufacture. Refer to the model number for the submitted unit configuration.
2. The heater coils shall be constructed of High Grade Nickel-Chrome alloy and will be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminal points shall be stainless steel insulated by means of non-rotating ceramic bushings.
3. The heater shall be equipped with fail-safe, automatic reset and manual reset disc-type thermal cut-outs.
4. The heater will include high limit cut-outs, magnetic contactors as required, a control transformer and an airflow switch.

1.7 UNIT LOCATION:

A. The unit shall be designed for indoor installation.

1.8 VENTILATION OUTDOOR AIR:

A. Evaporator Bypass: An automatic two-position evaporator bypass damper shall be provided. The bypass damper shall be located in fixed evaporator bypass opening. The damper shall be field-balanced to maintain constant evaporator airflow during unoccupied and occupied modes of operation.

1.9 OUTDOOR AIR ASSEMBLY:

A. The unit shall be supplied with an integral outdoor air intake assembly for the introduction of outdoor air. The outdoor air shall be introduced after the evaporator coil but before the reheat condensing coil. The complete assembly shall be field reversible (rotate 180°) to provide flexibility in the connection of the outside air ductwork. The outside air assembly shall include the following features:
1. A two-position, spring-return damper and actuator shall be provided to allow the system to bring in outdoor air during occupied time periods and to close during unoccupied times.
2. An outdoor air assembly box with duct connection shall be provided to house a 1" fiberglass disposable filter.

1.10 ELECTRICAL CONTROL PANEL:

A. The electrical control panel will be easily accessible on one side so that service can be performed from the side of the unit. It will be of adequate size so as to house all electrical controls and devices. The unit will be provided with single point power connection to serve controls, fans, electric auxiliary heater (if provided), and compressors, factory wired to the power connection lug set. The electrical controls will include low-voltage transformers to supply 24 VAC control power, clearly labeled high- and low-voltage terminal strips, high- and low-pressure control (with manual reset of the high-pressure cutout and automatic reset of low-pressure cutout), and an anti-short cycling timer to protect against compressor cycling.

B. Short Circuit Current Rating (SCCR): The complete unit shall be rated in compliance with NEC® 110.10 and UL 1995 at nameplate voltage maximum, when protected by Class J, Class T or Class RK1 fusing. Electrical markings on the unit shall include, but not limited to the MCA (Minimum Circuit Ampacity), the MOPD (Maximum Over-current Protection Device) and the SSCR.

1.11 CONTROL SYSTEM:

A. A digital control system using a modern microprocessor will be used to accurately and precisely control the DESERT AIRE dehumidification system and the space environment. The controller will include three (3) levels of password protection.

B. The controller will provide precise system control and feature an easy-to-read display which indicates actual operating and set-points. The display will be remote mountable up to 1,640 feet from the unit. The controller will have a built-in occupancy timer.
   1. Temperature & Humidity Sensor: The unit will include a temperature and humidity sensor either installed in the dehumidifier or shipped loose for wall mounting. See unit selection for details.
   2. BMS Compatibility: The unit's controller shall have the following BMS compatibility: BACnet MS/TP communication card
   3. The following Control Points will be available as read/write through the on board terminal or through the BMS system:
      Zone Air RH Setpoint
      Zone Air RH Deadband
      Zone Air Temperature Setpoint
      Zone Cooling Deadband
      Zone Cooling Stage Deadband
      Zone Heating Deadband
      Energy Recovery Deadband
      Pool 1 Temperature Setpoint (optional)
      Pool 1 Temperature Differential (optional)
      Pool 1 Stage Deadband (optional)
      Pool 2 Temperature Setpoint (optional)
      Pool 2 Temperature Differential (optional)
      Pool 2 Stage Deadband (optional)
      Network Occupancy Command (optional)
      Network Event Command (optional)
      Network Purge Command (optional)
      Network Off Command (optional)
      Remote Reset
   4. The controller will include the following alarms:
      Low Suction Pressure Circuit A
      Low Suction Pressure Circuit B
      High Discharge Pressure Circuit A
      High Discharge Pressure Circuit B
      Supply Air Sensor Failure
      Zone Air Sensor Failure
      Supply Fan Overload
      Compressor Circuit A Overload
      Compressor Circuit B Overload
      System Shutdown
      Low Supply Air Temperature
      Exhaust Fan Overload
      Low Voltage (optional)
      Low Air Flow
      Freeze Stat (optional)

C. Airflow Switch: The dehumidifier shall be equipped with an airflow switch to prevent the compressors from starting or operating on loss of airflow.

D. Condensate Drain Pan: The drain pan will be 20-gauge stainless steel, sloped, and positioned under the dehumidifier coil. The drain pan will be TIG welded and securely

attached to the evaporator endplates to avoid shifting. The drain pan will be fitted with a minimum 1" MPT non-corrosive plastic drain connection. The drain pan will meet all the requirements of ASHRAE Standard 62.

E. Insulation: The thermal and sound insulation shall be engineered polymer closed-cell foam insulation (EPFI). Indoor units shall have 3/8" thick insulation and outdoor units shall have 3/4" thick insulation. The insulation meets the following requirements:
NFPA 255 Flame Spread – 25
NFPA 255 Smoke Developed – 50
NFPA 255 Fuel Contributed – 0
NFPA 90A (2-2.4.2) and 90B
ASTM C5118 (Thermal Resistance)
ASTM C411 (Hot Surface Performance)
ASTM C423 (Sound Absorption)
ASTM C665 (Fungi Resistance)
ASTM E90 (Airborne Sound Trans. Loss)
ASTM E96 (Water Vapor Transmission)
UL 94HBF (Horizontal Burn)
UL 181 (Air Erosion, Mold Growth, and Humidity)
ASTM C1136 (Mold, Mildew, and Moisture Resistance)

1.12 SUPPLY FAN:

A. Supply fan will either be double inlet forward curve fan or double inlet air foil fan.
1. Double Inlet Forward Curve Fans: The fan housing shall be made of galvanized steel. The impeller is manufactured in galvanized steel with tab locked blades.
2. Double Inlet Air Foil Fans: The fan housing shall be made of galvanized steel. The high performance impeller is manufactured in corrosion resistant steel, with backward curved, true airfoil shaped blades, welded into position. All wheels are coated with an anticorrosive primer and a final layer of synthetic paint.

B. All bearings are selected for a minimum of a L50 Life time of 200,000 hours.

C. All fans shall be dynamically and statically balanced.

D. Blower Discharge: The unit's air discharge will be as shown on the drawing.

E. Blower Pulley Assembly: The driver pulley and the blower pulley will be made of cast iron. The motor sheave will be a variable pitch type to allow for field adjustment of CFM and external static

1.13 RETURN AIR FILTERS:

A. The system shall be provided with MERV 8 disposable filters consisting of 4" pleated filter.

1.14 APPROVALS/LISTINGS:

A. The unit shall be labeled and listed by ETL or UL.

1.15 UNIT MANUFACTURER:

A. The unit shall be manufactured by DESERT AIRE CORPORATION, Germantown, Wisconsin, U.S.A. The manufacture must be an active member of the ARI Dehumidification group.

PART 2 - EXECUTION

2.1 PREPARATION:

A. Installing contractor to provide all labor, refrigerant, and material required for a complete installation. Minimum of 3 feet clearance on all sides. Work to be performed shall be in accord with local codes, regulations, and OSHA standards.

2.2 DELIVERY, STORAGE, AND HANDLING:

A. Customer to provide a suitable space for the equipment with proper access and entries. Unit to be stored in a clean, dry place and protected from the outdoor environment. Handle with care to avoid damage.

2.3 INSTALLATION:

A. Unit shall be installed per plans and manufacturer's installation recommendations.

2.4 FIELD QUALITY CONTROL:

A. Installing contractor to clean, check, and perform all preliminary start-up procedures before final operation of the unit, per manufacturer's recommendations.

2.5 OPERATION/MAINTENANCE MANUALS (IN ENGLISH):

A. Manuals will include electrical and control drawings, and refrigeration piping drawings. Manufacturer's representative shall instruct owners/operators of the unit regarding its functions and sequence of operation.

END OF SECTION

DIVISION

26

ELECTRICAL

SECTION 26 00 00 - ELECTRICAL GENERAL PROVISIONS – COMMISSIONING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Division 26 will be responsible to carry out the commissioning requirements specified in Section 01 91 13 and other sections referenced in 01 91 13.

END OF SECTION

SECTION 26 01 00 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. The scope of work is as indicated on electrical drawings and includes but is not limited to the following:

B. Site:

1. Coordination with the local utility company and provide primary conduits with pull boxes to utility tie-in point, per utility co. specifications. Provide secondary conduit, pull boxes, and service termination. Include all Utility Company fees for service connection in bid.
2. Coordinate communication services with the local telecommunication company and provide service conduit with pull rope to locations stipulated by Utility Company.
3. Provide a diesel emergency generator, automatic transfer switch, and associated emergency power feeders.
4. Provide temporary construction power; coordinate with the local Utility Company.
5. Provide in-ground pull boxes, manholes, and conduit as requires to serve any/all electrical equipment located throughout the site.
6. Provide concrete foundation for automatic transfer switch, docking stations, generator, and other floor mounted equipment.
7. Provide power and fire alarm connection to backflow preventer.
8. Provide site lighting poles and associated branch circuits.
9. Provide circuit to site monument signage.
10. Provide fiber IDF cabinet on site with fiber cable back to MDF. Provide CAT 6 to monument signage.
11. Provide panelboards and transformers throughout site to supply power to car chargers, site lighting, and fountains.
12. Provide connection to fountains located in pond.
13. Provide pedestrian site lights around walking track.
14. Provide emergency call boxes and locate throughout parking and near track as indicated on plan.
15. Provide electric vehicle charging stations, foundations, cat 6 cabling, etc as indicated on plan.
16. Throughout the site provide outdoor rated IDF racks with fiber cabling to MDF. Outdoor racks will house switches, patch panels, etc to serve marque signage, electric vehicle charging stations, etc.

D. Power:

1. Provide panel, safety disconnect switches and associated feeder(s).
2. Provide receptacles, special outlets, junction boxes, and their associated branch circuits.
3. Provide branch circuits associated with all kitchen equipment furnished Coordinate with Food Service Consultant drawings prior to bid and include all necessary connections for a complete and functional system.
4. Provide branch circuits to kitchen hood and interconnect associated supply and exhaust fan to hood control panel. Connect equipment below hood to hood

extinguishing system. Connect equipment beneath hood and supply fan to shunt trip breakers interconnected to the hood control panel.

5. Provide branch circuits associated with all medical equipment furnished. Coordinate with manufacturer specifications and drawings prior to bid and include all necessary connections for a complete and functional system.
6. Provide branch circuits associated with all mechanical and plumbing system equipment, including all accessories such as motorized dampers, valves, fan interlocks, ionization, etc.
7. Provide branch circuits associated with all pool & spa equipment furnished including but not limited to underwater lighting, scoreboard, timer system touch pads, and pumps. Coordinate with pool equipment drawings prior to bid and include all necessary connections for a complete and functional system.
8. Provide recessed concealed service floor boxes with GFCI receptacles for exercise equipment.
9. Provide feeders and branch circuitry for elevators. Include elevator shunt trips and interconnect to fire alarm system. Provide elevator disconnect switches, receptacles, lighting, etc per manufacturer specifications.
10. Provide bus bars in all electrical rooms. Interconnect bus bars per grounding riser diagram.
11. Provide surge suppression devices on all panelboards.
12. Provide a metering system as shown on one-line diagram. Metering system shall include webpage with custom one-line diagram to represent all devices and meter outputs.
13. All exterior disconnects and panelboards shall be NEMA-3R.
14. Provide all branch circuits required for A/V system located in Convention Room.

E. Lighting:

1. Lighting control shall adhere to all requirements of IECC 2021
2. Provide interior light fixtures, wall switches, wall dimmers, and occupancy sensors and associated branch circuits.
3. Provide all interior/exterior building mounted fixture and associated branch circuits.
4. Provide exit light fixtures and both interior and exterior emergency light fixtures.
5. All lighting shall be controllable via the Building Management Control System (BMCS). Provide connectivity from lighting control panels to BMCS.
6. For all site lighting fixtures provide pole foundations. Refer to pole detail on plans and structural plans for more information.

F. Telecommunications:

1. Provide junction boxes and conduit for phone and data outlets. Provide (2) CAT 6 cables to each data outlet shown unless otherwise indicated.
2. Provide 3/4” plywood lumber core backboard. Paint with two coats of fire retardant paint on both sides.
3. Provide floor mounted data racks in all MDF and IDF rooms. Provide single mode fiber cabling throughout to connect from MDF (located in central plant) to all IDF. Multi-mode fiber is prohibited on this project.
4. Provide ladder rack in telecommunications rooms.
5. Provide grounding bus bars in all telecommunications room and interconnect according to grounding riser diagram.
6. Provide two (2) CAT 6 cables to the fire alarm control panel

7. Provide two (2) CAT 6 cables to Building Management Control System Panels
8. Provide two (2) CAT 6 cables to lighting control panels.
9. Provide CAT 6 cables to all metering points illustrated on the one-line diagram.
10. Provide CAT 6 cables to all lighting control panels for connection to BMCS.

G. Fire Alarm:
1. Provide fire alarm control panel, voice evacuation panel and remote booster panels.
2. Provide manual pull stations at reception desk and where indicated on plan.
3. Provide visual and audio notification throughout including voice evacuation.
4. Provide smoke detectors at all control panels, voice evacuation panels and booster panels.
5. Provide duct mounted smoke detectors for all air units with greater than 2000 cfm air flow.
6. Provide a monitor module for all sprinkler system tamper and flow switches.
7. Provide a monitor module for sprinkler system hotbox heater power and tamper switches.
8. Provide a monitor module for kitchen hood suppression system.

H. Nurse Call
1. Nurse call system cabling & devices by others. Where nurse call dome lights and pull cords are illustrated on plan contractor shall provide back box and 1” C. with pull string to accessible location above ceiling.

I. Access Controls and Cameras
1. Provide a minimum of one (1) dedicated 120V circuits for access control and camera equipment in each telecommunications closet.
2. Provide junction box and 1” C. with pull string to accessible location above ceiling for all access and camera locations. All cabling by others.

J. Paging and Music Systems
1. Provide a minimum of one (1) dedicated 120V circuits for paging and music systems in each telecommunications closet.
2. Provide junction box and 1” C. with pull string to accessible location above ceiling for all speaker locations. All cabling by others.

K. Lightning Protection System
1. Provide a complete lightning protection system in accordance with specification 26 4113.

1.2 GENERAL CONDITIONS

A. The General Conditions and Supplementary General Conditions are a part of this section of these Specifications. The Contractor is cautioned to read and be thoroughly familiar with all provisions of the General Conditions. These conditions shall be complied with in every aspect.

1.3 DEFINITONS:

A. The word "shall" where used, is to be understood, as mandatory and the word "should" as advisory. "May" is used in the permissive sense.

B. Concealed: Concealed areas are those areas that cannot be seen by building occupants.

C. Exposed: Exposed areas are all areas that are exposed to view by building occupants, including areas below counter tops, inside cabinets and closets, inside all equipment rooms, and areas outside the building exterior envelope.

D. Feeder: Feeder consists of both conduit and wiring installed above or below grade

E. Provide: Provide shall including furnishing, installing, and connecting the item or items referenced unless specifically indicated otherwise.

1.4 QUALITY ASSURANCE

A. General:
1. Every effort has been made by the Engineer to clearly indicate all devices/equipment requiring an electrical/data connection. It is the intent of the Engineer that all light fixtures be powered and controlled, that all devices and equipment be circuited to a panelboard of appropriate voltage and breaker of MOCP not exceeding manufacturer’s specifications. That all communications, security, and fire alarm devices are installed, wiring, and functioning properly.
2. Where there is a conflict between the contract document and an applicable Code. The Code shall govern except where the requirements of the contract documents are more stringent. The most stringent requirement shall apply.
3. All work shall be concealed unless specifically noted to be exposed.
4. Coordinate the exact locations of electrical outlets and equipment with building features and equipment as indicated on architectural, structural, mechanical, plumbing, landscape, and food service drawings. Review any/all proposed changes in electrical device/equipment locations with Architect prior to rough-in. Architect may direct relocation of outlets before rough-in, up to ten (10) feet from the position indicated, without additional cost. Remove and relocate outlets placed in unsuitable locations when requested by the Architect, at no additional cost.
5. Resolve, in writing, any code violation discovered in contract documents with the Engineer prior to bidding. After award of the contract, Contactor shall make any correction or addition necessary for compliance with applicable codes at no additional cost.

B. An approved contractor for the work under this division shall be:
1. A licensed electrical contractor in the jurisdiction in which the work shall be performed.
2. Able to furnish evidence of having contracted for and installed not less than three (3) systems of similar size and scope.

C. All work, materials and equipment shall comply with the latest applicable codes, local ordinances, and UL requirements.

D. Provide new products of manufacturers regularly engaged in production of such

equipment. Provide the manufacturer's latest standard design for the type product specified. All new products shall be listed for the use shown on drawings.

E. Equipment shall be delivered with a factory-applied finish so that no additional field painting is required.

F. Equipment shall be selected to conform the building space limitations. Do not provide equipment that cannot meet the arrangement requirements shown on plans. Contractor shall submit room layouts with submitted items shown drawn to scale. Submittals will be rejected without floor plan Drawings showing submitted items.

G. All equipment included in the service and distribution specifications shall be provided by the same manufacturer.

H. Manufacturer names and model numbers are subject to change. Contractor shall verify them with manufacturer's representative prior to ordering any product or equipment.

1.5 GENERAL REQUIREMENTS

A. The Contractor is referred to all of the Drawings for building construction as well as the electrical Drawings.

B. The Contractor shall examine the site and shall verify to his own satisfaction the location of all utilities, and shall adequately inform himself as to their relation to his work before entering into a Contract and he shall base his bid on any conditions, which may be encountered during the progress of the work.

C. The Contractor shall furnish and install properly all materials, devices, equipment, supports, controls, appurtenances, etc., mentioned or required to make complete or satisfactory installations in working order whether shown or not. All electrical equipment shall be connected in accordance with manufacturer's instructions. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance when completed.

D. The Contractor shall provide finished to match approved samples; all exposed finishes shall be approved by the Architect. Submit color samples as required.

1.6 APPLICABLE GENERAL CODES AND REGULATIONS

A. All electrical work and equipment, in whole or in part, shall conform to the applicable portions of the following specifications, codes and regulations in effect on that date of invitation for bids, and shall form a part of this specification.

B. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition.

C. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
   1. NFPA 70, National Electrical Code
   2. National Fire Codes:
      a. NFPA 70E, Electrical Safety Requirements for Employee Workplaces

b. NFPA 72, National Fire Alarm Code
c. NFPA 77, Static Electricity
d. NFPA 99, Health Care Facilities
e. NFPA 101, Life Safety Code
f. NFPA 110, Emergency and Standby Power Systems

3. Occupational Safety and Health Regulations (OSHA).
4. NFPA Standards in effect shall be as listed or adopted by the Louisiana authority having jurisdiction.
5. American National Standards Institute (ANSI)
6. Institute of Electrical and Electronics Engineers (IEEE)
7. Local, City and State Codes and Ordinances
8. Regulations and standards of the Electric Utility Company
9. National Electrical Safety Code (NESC)
10. National Electrical Manufacturers Association (NEMA)
11. Insulated Power Cable Engineers Association (IPCEA)
12. International Building Codes (IBC)
13. International Energy Conservation Codes (IECC)

B. Equipment that has been inspected and approved by the Underwriter's Laboratory shall bear its label or appear on its list of approved apparatus.

1.7 DRAWINGS

A. Plans and detail sketches are submitted to limit, explain, and define conditions, specified requirements, conduit sizes, and manner of erecting work. The Contractor is cautioned to field check and verify all existing conditions before bidding, as no extra compensation will be allowed for conditions found different than represented in the construction drawings and/or specifications. Written approval of the Architect shall be obtained prior to any alterations or additions to specified work.

B. Structural or other conditions may require certain modifications from the manner of installation shown, and such deviations are permissible and shall be made as required, but specified sizes and requirements necessary for satisfactory operations shall remain unchanged.

C. The drawings and these specifications are complementary to each other and what is called for by one shall be binding as if called for by both.

D. General arrangement of work is indicated on plans. Due to the small scale of the drawings, offsets, fittings, and boxes required are not all indicated; provide fittings, boxes, etc., as needed in accordance with codes and accepted practices.

1.8 SUPERVISION

A. The Contractor shall personally or through an authorized and competent representative, constantly supervise the work from beginning to completion and final acceptance. So far as possible, he shall keep the same foreman and workmen throughout the project duration.

B. During its progress, the work shall be subject to inspection by representatives of the Architect or Engineer, at which times the Contractor shall furnish required information.

C. It is not the Architect's or Engineer's duty to direct or guarantee the work of the Contractor, but to assist the Owner in obtaining a complete building in accordance with plans, specifications and addenda and to furnish engineering services in accordance with recognized practices.

1.9 PRIOR APPROVALS

A. The Contractor shall base his proposal on materials as specified herein. Any references to a specific manufacturer or trade name is made to establish a standard of quality and to define a type of product and in no way is intended to indicate a preference for a particular manufacturer. It is the intent of these specifications to allow all manufacturers of equipment, products, etc., judged by engineer equal to the specified product to bid on a competitive basis.

1.10 MEASUREMENTS

A. The Contractor shall verify all measurements and shall be responsible for the correctness of same, before ordering any materials or doing any work. No extra charge or compensation will be allowed for any differences between the actual measurements and those indicated on the drawings.

1.11 LAWS, PERMITS AND FEES

A. The entire electrical work shall comply with the rules and regulations of the City, Parish, and State, including the State Fire Marshal and State Board of Health, whether so shown on plans or not. The Contractor shall pay fees for permits, inspections, etc., and shall arrange with the inspecting authorities all required inspections.

1.12 SITE INSPECTION

A. The Contractor shall visit the site and familiarize himself with difficulties attendant to the successful execution of the work before bidding. Failure to visit the site shall not relieve the Contractor of the extent or conditions of the work required of him.

1.13 TEMPORARY FACILTIES

A. The Contractor shall provide all temporary power and lighting for construction purposes. Installation of temporary power shall be in accordance with NEC Article 527.

B. Temporary facilities, wire, lights, and devices are the property of the contractor and shall be removed by the Contractor at the completion of the Contract.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. All materials, equipment, and accessories installed under this Contract, whether approved or not, shall be new and shall conform to all rules, codes, etc., as recommended or adopted by the National Association(s) governing the manufacture, rating and testing of such materials, equipment, and accessories.

B. Product Substitutions
   1. If item of equipment or device offered as Substitution differs in dimension or configuration from that indicated in the Contract Documents, provide, as part of the substitution submittal, a drawing that shows that the equipment or devices proposed for Substitution can be installed in the space available without interfering with other trades or with access requirements for operations and maintenance in the completed project. Drawings shall be of appropriate scale but shall not be smaller than a scale of 1/4-inch equals one foot.
   2. Where substitute equipment or devices requires different arrangement or connections from that indicated in the Contract Documents, install the equipment or devices to operate properly and in accordance with the requirements of the Contract Documents. Make incidental changes necessary in piping, ductwork or wiring which results from the inclusion of the substitute equipment or device without any additional cost to the Owner. Pay all additional costs incurred by other trades in connection with changes required by the inclusion of the substituted equipment or device in the Work.

2.2 SHOP DRAWINGS & SUBMITTALS

A. Shop drawings shall be taken to mean detailed drawings with dimensions, schedules, weights, capacities installation details, and pertinent information that will be needed to describe the material or equipment in detail.
   1. Shop drawings shall be prepared using computerized digital software compatible with AutoDesk's AutoCAD
   2. Submit (3) hardcopy of Shop Drawings. Hardcopies of Shop Drawings shall have each sheet clearly labeled with a unique sheet identification number.
   3. In addition to hardcopies required by Division 01, submit one copy of Shop Drawings in electronic format on Flash Drive. Files contained shall be named to correspond with the sheet names contained in the hardcopy set. Files on shall include both AutoCAD compatible source files and files printed to Portable Document Format (.pdf).

B. Submittals shall be taken to mean catalog cuts, general descriptive information, catalog numbers, and manufacturer's name.

C. Review of submittals or shop drawings shall not remove the responsibility for furnishing materials or equipment of proper dimensions, quantity and quality; nor will such review remove the responsibility for error in the shop drawings or submittals.

D. Assume all costs and liabilities, which may result from the ordering of any material, or equipment prior to the review of the shop drawings or submittals, and no work shall be done until the shop drawings or submittals have been reviewed. In case of correction or rejection, resubmit until such time as they are accepted by the Owner's representative and such procedures will not be cause for delay. After the final review, 6 copies will be supplied if requested.

E. Shop drawings and submittals will be returned unchecked if the specific items proposed are not clearly marked, or if the general Contractor's approval stamp is omitted.

F. Shop drawings, unless mark-ups are very trivial, will not be returned, "No Exception Taken". They will be returned for re-submittal as many times as necessary, however, the Contractor shall be back charged for engineering review time beginning with the second resubmittal. Therefore, the Contractor should make every effort to comply with the requirements of this Project on the first submittal in order to avoid project delays.

G. The Contractor shall submit to the Architect complete descriptive and dimensional data on the following items for review and approval when specified or provided:
1. Cable Tray
2. Disconnect Switches
3. Electrical Contactors
4. Electrical Controls and Time Switches
5. Emergency/Standby generator set and transfer switches
6. Enclosed Circuit Breakers
7. Fire Alarm System Panels, Initiation Devices, and Annunciation Devices
8. Fire Rated Cables and Connectors
9. Lighting Controls and Occupancy Sensors
10. Lighting Fixtures
11. Lightning Protection System
12. Panelboards and enclosures
13. Site Lighting Poles and Fixtures
14. Surface Raceways
15. Surge Protection Devices
16. Switchboards
17. Transformers
18. Wiring Devices
19. Scada Systems
20. Emergency Call Boxes
21. Telecommunication Racks & Cabling
22. Electric Vehicle Charging Stations (EVCS)

PART 3 - METHODS OF INSTALLATIONS

3.1 CONTRACTOR COORDINATION

A. The Drawings are diagrammatic in nature. Cooperate with other trades so the interferences of facilities and equipment will be avoided.

B. Contractor to coordinate with door hardware provider, architect and owner prior to installation of any devices associated with doors to verify door operational requirement, placement of proximity readers, motion sensors, door switches, fire alarm control, magnetic locks, hold open devices, etc..

C. Contractor to coordinate with hospital equipment provider prior to installation of circuits, conduit and boxes for all hospital equipment. Contractor shall refer to hospital equipment shop drawings for installation and rough in requirements. Locations and circuit sizes indicated on the drawings shall be verified with final hospital equipment drawings.

D. Contractor to coordinate with architectural millwork shop drawings prior to rough-in for locations of under counter lighting to be installed in and around millwork. No receptacles shall be installed in an enclosed cabinet unless noted on the drawings. Outlets for refrigerators, microwaves, etc. shall be installed in the space identified on the millwork shop drawings.

E. Contractor shall not penetrate any stair wall assemble with conduit, boxes, cabling and the like, except for items that serve the stairwell.

F. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer. Verify that all materials, equipment and devices proposed for use on this Project are within the constraints of the allocated space.

G. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping installed at required slope. So, connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

H. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

I. Coordination Drawings: Prepare BIM coordination models showing dimensioned layout for the following and clash detection:
1. Penetration and structural opening: Floor plans showing sleeves and formed structural penetrations. Shoe sleeve and formed penetration layout and relationships between structural components and their adjacent building elements, including but not limited to pre-tensioning and post-tensioning members where used.
2. Reflected Ceiling Plans: ceiling plans, sections, and other necessary details showing dimensioned layouts for equipment located in or on the ceiling plane. Base dimensions on exact dimensions layout for equipment located in or on the ceiling plane. Base dimension on exact dimensions data obtained from product submittals for products to be included in the work. Differentiated between field measurements and assumed dimensions. Include the following items coordinated with each other, based on input form installers the items involved:
    a. Suspended ceiling components
    b. Structural members to which suspension systems for luminaires will be attached.
    c. Perimeter moldings, decorative ceiling elements, and Architectural features.
    d. Luminaries
    e. Speakers
    f. Sprinklers
    g. Smoke detectors
    h. Fire alarm notification appliances
    i. Occupancy sensors
    j. Access panels.
    k. Security cameras
    l. Wireless Internet Access Points
    m. Nurse Call Zone and Dome Lights
3. Electrical Equipment Layouts: Floor plans, elevations, and other necessary details showing dimensioned layouts for spaces containing electrical equipment. Base electrical equipment dimensions on exact dimensioned data obtained from product submittals for products to be included in the Work. Differentiate between field measurements and assumed dimensions. Include the following items coordinated with each other, based on input from installers of the items involved:
    a. Electrical equipment layout and relationships between components and adjacent structural and mechanical elements.
    b. Indication of required working clearances and required area above and around electrical equipment where pipes and ducts are prohibited.
    c. Location of Conduit entry into electrical equipment.
    d. Location of luminaires, sprinkler piping and heads, ducts, and diffusers.

e. Electrical equipment support locations, type of support, and weight on each support.
f. Location of structural supports for structure-supported raceways.
g. For floor mounted equipment: concrete base dimension, outline of equipment, and required clearances.

3.2 OPENINGS, CUTTING AND PATCHING

A. Cut all openings as required for the electrical work. Patching will be done by the various crafts whose work is involved. Furnish and install all necessary sleeves, thimbles, hangers, inserts, etc., at such times and in such a manner as not to delay or interfere with the work of other Contractors. Caulk, flash or otherwise make weatherproof all penetrations through the roof and exterior walls.

B. Where conduit, cable or other items that are provided for under this contract penetrate fire rated walls or floors, the Contractor is to seal around the item to maintain the integrity of the rated system.

3.3 ACCESSIBILITY AND DEVICE MOUNTING HEIGHTS

A. All electrical devices shall be installed in compliance with the Americans with Disabilities Act (ADA) and local accessibility codes. Typical mounting heights shall be as follows unless noted otherwise on the drawings or required by authority having jurisdiction:

Device Type	Mounting Height (AFF to Center unless noted)
Duplex receptacles (general use)	18″
Data / communication outlets	18″
Above Counter	4” Above countertop
Wall switches / dimmers / occupancy sensors	48″
Thermostats / control panels	48″
Fire alarm pull stations	42″ (to operable part)
Wall mounted Fire alarm horn/strobes	80″ min. to bottom, 96″ max. to top
Exit signs	As required by Life Safety Code, typically above doors with bottom at 80″ min. AFF
Wall mounted Nurse call dome lights	80″ min.
Card readers / access controls	48″
Audio/visual devices (TV, monitors, etc.)	Coordinate with architect/owner

3.4 PAINTING

A. Painting shall be performed as described in the painting specifications. No painting will be required by the Contractor except for touch-up of factory finishes on equipment furnished under this contract.

3.5 INSTALLATION

A. Housekeeping Pads: All floor and ground mounted electrical equipment - panels, switchboards, motor control centers, transformers, etc. shall be installed with a reinforced concrete housekeeping pad, whether shown on the drawings or not. The pad shall extend 4” above either the finished floor or final grade (as applicable), have 45 degree chamfered edges, and be constructed of 3000psi concrete. The pad shall extend 3”

beyond the edge of the respective electrical equipment. Concrete shall have smooth steel trowel finish.

B. Equipment must be leveled and set plumb. Use corrosion resistant mounting hardware. For sheet metal enclosures mounted against a wall provide corrosion-resistant spaces to separate the wall by 1/4 inch or by 3 inches of air for freestanding units.

C. Unused knockouts on panels and boxes shall be covered with approved cover plates manufactured for the purpose.

3.6 TESTS AND INSPECTIONS

A. The Contractor shall assist in making periodic inspections or tests required by the Architect or Engineer. When requested, the Contractor shall provide the assistance of foremen and qualified craftsmen for reasonable duration of each test, etc.

B. The contract will not be declared to be substantially complete until all of the following conditions are satisfied.
   1. the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.
   2. The “As-Built” drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner’s Construction Representative.
   3. The various systems and building emergency lighting system have been commissioned and accepted.
      a. Building Lightning protection System
      b. Data / Voice Cabling System
      c. Emergency Lighting System
      d. Fire Alarm System
      e. Intercom / Telephone
      f. Lighting Occupancy Sensor Controls
      g. Surveillance and Security System

3.7 SAFETY PRECAUTIONS DURING CONSTRUCTION

A. It shall be the Contractor's responsibility to furnish and install proper guards and instruction signs for prevention of accidents and to provide and maintain for the duration of construction any installations needed for safety of life and property.

3.8 CONNECTIONS

A. This Contractor shall be responsible for providing electrical service to all devices of the heating and air conditioning system, and is referred to the mechanical plan for the exact location of the various devices.

B. Mechanical Controls: Provide 120VAC power connections as required to components of Mechanical Control system. Coordinated quantity of circuits, connection requirements and locations between trades and with provisions of Divisions 21, 22, and 23 sections.

C. Security and Access Control: Where the Drawings indicate a 120VAC circuit in a general area labeled for security or access control use, the intent is for this circuit to be extended and connected to the security or access control device in that general area in coordination with other trades. Coordinate connection requirements and locations between trades and with Owner’s Security vendor prior to installation.

D. Motors and Motor Connections: Motors for driven equipment are specified in Divisions 21, 22, and 23. Provide connections as follows, unless otherwise indicated:
   1. Equipment provided with factory installed disconnecting means: Upon installation of motor and associated equipment, Provide the electrical installation in accordance with approved wiring diagrams and manufacturer's written instructions.
   2. Equipment furnished with factory disconnecting means: Upon installation of motor and associated equipment, Install factory furnished disconnecting means and provide the electrical installation in accordance with approved wiring diagrams and manufacturer's written instructions.
   3. Equipment not furnished with factory installed disconnecting means: Provide disconnect switch required in accordance with NFPA 70 or as indicated on the Drawings. Provide the electrical installation in accordance with approved wiring diagrams and manufacturer's written instructions.

3.9 LOAD BALANCING

A. Balance load on all phases in each panel to within 10% of respective phase loads.

3.10 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment: Refer to specification 26 05 53 Identification for Electrical Equipment systems.

3.11 COMPLETION

A. The Contractor shall leave all electrical equipment with proper connections, and in proper working order. He shall test the entire electrical system to show that it is properly installed. Contractor shall leave all panels and switches completely fused or complete with circuit breakers.

3.12 RECORD DRAWINGS

A. The Contractor shall furnish one (1) complete set of drawings on which any changes in the work shall be shown. In addition to changes in work contractor shall clearly indicate routing of all feeders both above and below ground. All underground conduit shall be noted on drawings to show "as built" locations. These drawings must be turned over to the Architect prior to final acceptance of the work.

3.13 GUARANTEE

A. The Contractor shall guarantee to keep the entire electrical system as installed by him or his subcontractors in repair and free from defects in materials and workmanship for one (1) year from the date of the substantial completion, and shall furnish free of cost to the Owner, all material and labor necessary to comply with the above guarantee; said guarantee shall be based upon defective material and workmanship. In any case where equipment has a factory warranty exceeding this one-year limit, the full extent of the warranty shall apply.

B. Extended Warranty Options: for equipment such as generators, transfer switches, and switchgear. Extended warranty options shall be presented to the owner for consideration.

3.14 CLEANING

A. When all work has been finally tested, the Contractor shall clean all fixtures, equipment, conduits, ducts, and all exposed work. All cover plates and other finished products shall be thoroughly cleaned.

3.15 VANDAL RESISTANT DEVICES

A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.

B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.16 INSTRUCTION MANUALS

A. The Contractor shall provide three (3) operating and maintenance instruction manuals on all systems and equipment installed in the electrical work.

B. The Contractor shall provide (3) copies of all warranties and guarantees for systems, equipment, devices, and materials.

C. Final Payment will be withheld until A & B are delivered.

3.17 CONTRACTOR SPECIAL NOTE

A. The Contractor is again cautioned to refer to all parts of these Specifications and all Drawings, not just electrical sections, and the individual cross references made to other standard specifications or details describing any electrical work, which may be required under these other sections. The Contractor is cautioned to note carefully any other sections which may reference electrical work in order for this Contractor to fully understand the wiring requirements and electrical work that is required. Any conflicts found between the electrical sections of these Specifications or Drawings shall be immediately directed to the General Contractor for clarification.

B. These Specifications and the electrical Drawings size equipment, wire, conduit, etc. based on the horsepower of motors and/or wattages of equipment as shown on the plans or specified herein. The Contractor shall install electrical raceways, conductors, fuses, safety switches, breakers, contactors, starters or any other electrical equipment with the capacities to suit the horsepower and/or wattages of the equipment actually furnished and installed. The Contractor shall not furnish or install any electrical raceways, conductors, safety switches, contactors or motor starters of sizes smaller than those shown on the Drawings or specified herein. The Contractor shall coordinate with the various sections of the Specifications and/or Drawings and with the various Sub-Contractors to provide the properly sized equipment without additional cost to the Owner.

END OF SECTION

SECTION 26 05 10 - UTILITY COORDINATION SERVICE ENTRANCE

PART 1 GENERAL

1.1 WORK INCLUDED

A. General: Electrical service shall be provided by local utility company. Provide infrastructure, conduit, ductbanks and pathways from public street right-of-way to building for telecommunications and cable service.

B. Power Company Data: Obtain from utility company information and installation standards for electrical, telecommunication, and cable service installation.

C. Responsibilities: Determine what equipment and labor is provided by utility company and what equipment and labor is required of this Contractor.

PART 2 PRODUCTS

2.1 PRIMARY SERVICE

A. General: Division 26 shall provide primary service conduit, manholes, and pull boxes as required and as specified for electrical service. Division 26 shall provide grounding rods, grounding conductors, sleeves, conduits, pull boxes and manholes as required by telecommunications and cable service providers.

B. Electric utility company shall provide transformer, primary cables, splices, terminations, and primary underground service conductors. Telecommunications and cable service utility companies shall provide cabling and connections to the Owner’s demarcation point of service.

2.2 SECONDARY SERVICE CABLE TAP BOXES

A. When required by local utility company contractor shall provide a NEMA-3R demarcation junction box per company standards.

2.3 SECONDARY SERVICE CONDUCTORS

A. General: Division 26 shall provide secondary service entrance conductors and conduit.

B. Where required by local utility standards provide in-grade pull boxes.

PART 3 EXECUTION

3.1 INSTALLATION

A. The installation of the service entrance provisions shall comply with the published standards and requirements of the utility company, the utility company’s specific construction requirements for this project, and with requirements of this Division.

B. Any failure to meet the standards and requirements shall be corrected to the satisfaction of the utility company and Owner without any additional cost to the Owner.

C. Contractor shall provide all construction materials and labor that the utility company determines to be the responsibility of the customer, at no additional cost to the Owner.

D. The materials and labor required by Contractor the for a complete installation shall be provided by the contractor and includes, but is not limited to permanent or removable /

lockable vehicular barriers, grounding rods, grounding conductors, sleeves, concrete pads, conduits, metering racks and metering enclosures.

E. Primary distribution poles and service entrance ductbank locations shall be staked and surveyed prior to pole installation by the Contractor to verify their proper placement is within the Owner's property and respective utility easements. Contractor shall verify by survey that the pole and service entrance ductbank location and easements do not interfere with existing easements, right-of-ways, or other restricted properties. Conflicts with existing easements and restrictions shall be brought to the attention of the Architect prior to construction.

F. Contractor shall initiate contact with the utility providers and Owner within 14 days of Notice to Proceed to ensure permanent power will be available to the site. Any delays resulting from lack of this coordination shall be the responsibility of the Contractor.

END OF SECTION 26 05 10

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. building wires and cables rated 600V and less
   2. Connectors, splices and terminations rated 600 V and less
   3. Sleeves and sleeve seals for cables

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70- Latest edition as adopted by the LA state Fire Marshall or edition enforced by state and local code authority.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Refer to Part 3.1 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

B. Conductor Material: Copper unless indicated otherwise on Drawings; stranded conductor or solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

C. Conductor Insulation Types: Comply with NEMA WC 70 for Types THHN-THWN, and SO as indicated.

D. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

E. Conductor Temperature Rating: Provide conductors with 75 degree C rating. For high temperature applications, provide conductors with temperature ratings in accordance with NFPA 70 for ambient condition.

PART 3 EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-

THWN, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway .

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

I. Fire Alarm Cabling: Plenum rated. Secured per NFPA 70-760.

J. Contractor to provide metal raceway in Patient Care Areas per 517.13. Raceway shall be installed as a redundant ground.

K. Combining of more than three circuits in a conduit is not allowed. IE no more than three phase conductors.

L. Single Phase Circuits: Provide a dedicated neutral. Sharing of neutrals is not allowed.

M. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel,wire-mesh, strain relief device at terminations to suit application.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Run feeders in continuous lengths, without joints or splices. Where continuous runs are impractical; obtain Engineer’s approval for splice locations and application.

C. Make joints in branch circuits only where circuits divide.

D. Do not use gutters of panelboards as raceways, junction boxes, or pull boxes for conductors not terminating in said panelboards.

E. Run conduits for emergency power conductors separate from all other wiring.

F. Bundling Conductors: Bundle conductors in switchboards, panelboards, cabinets, and the like, using nylon ties made for the purpose. Bundle conductors larger than No. 10 in individual circuits. Smaller conductors may be bundled in larger groups.

G. Terminations of multiple branch circuit conductors on a single circuit breaker is not acceptable.

H. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours. Install all conductors in raceways, unless specifically noted otherwise.

I. Support cables according to Section 26 01 00 "Basic Electrical Requirements."

J. Identify and color-code conductors and cables according to Section “Identification for Electrical Equipment”

K. Sizes:

1. Provide conductors no smaller than No. 12 AWG, except for signal or control circuits.
2. Use #10 AWG conductors for 20 amperage 120V circuits when the circuit conductors are longer than 75 feet.
3. Use #10 AWG conductors for 20 amperage 277V circuits when the circuit conductors are longer than 200 feet.
4. Provide neutral conductors of the same size as the phase conductor(s) for individual branch circuit homeruns.

3.3 WIRE PULLING

A. Pull no conductors into conduits until all Work of a nature which may cause injury to conductors is completed.

B. Follow manufacturers' recommendations for regulating temperature conditions of conductors prior to installation.

C. Exercise care in handling and installing cables to avoid damage. Carefully form cables in equipment pull boxes. Form bends in cables larger than the minimum radii shown in the cable manufacturer's published data for minimum bends such that bends will not reduce the cable life.

D. Provide suitable installation equipment to prevent abrasion and cutting of conductors by raceways during the pulling of conductors. Use ropes of polyethylene, nylon or other suitable non-metallic material to pull in feeders. Metallic ropes are prohibited.

E. Before any wire is pulled into any conduit, thoroughly swab the conduit to remove all foreign material and to permit the wire itself to be pulled into a clean, dry conduit.

F. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B

B. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

C. Provide temperature ratings of connectors and splices to match wire rating.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. NFPA 70 and IEEE C2 include basic grounding requirements for electrical safety. This Section supplements the minimum safety requirements of the Code with requirements for additional grounding and with optional grounding methods and materials for both power and electronic systems.

B. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
   1. Underground distribution grounding.
   2. Common ground bonding with lightning protection system.

C. Related Sections include the following:
   1. Division 26 Section 26 41 13 "Lightning Protection Devices " for common ground bonding with lightning protection system.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with NFPA 70

D. Comply with IEEE C2

E. Comply with ANSI/EIA/TIA-607

PART 2 PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
   6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
   7. Main Bonding Jumper: stranded copper conductors sized as indicated on Drawings.
   8. Grounding Electrode Conductor: stranded copper conductors sized as indicated on Drawings.
   9. Common Grounding Electrode Conductor: stranded copper conductors sized as indicated on Drawings.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 4 inches (6 by 100 mm) in cross section, unless otherwise indicated; with insulators. Length as indicated on Drawings.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch (19 mm) diameter by 120 inches (3000 mm) long, unless otherwise indicated.

PART 3 EXECUTION

3.1 APPLICATIONS

A. Conductors: Install insulated solid conductor for No. 10 AWG and smaller, and insulated stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum, unless otherwise indicated.
   1. Bury at least 30 inches (762 mm) below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone/communications equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

E. Conductor Terminations and Connections: Use the following connectors styles, unless otherwise indicated.
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Exothermic Welded connectors, except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Exothermic Welded connectors.
   5. Connections to Ufer Ground: Exothermic Welded connectors.

F. Comply with ANSI-607 requirements for telephone/communications grounding riser
   1. Provide independent, fully-sized grounding pathway to each telecommunication branch

closets.

2. Interconnect vertical grounding risers horizontally at a minimum of every three floors, unless indicated otherwise.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Handholes: Install a driven ground rod through handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before handhole/manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Pad-Mounted Transformers and Switches: The following is a minimum if the utility company

does not have requirements, otherwise meet the utility company requirements. Install two ground rods and a ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformer, switch, or substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the edge of foundation.

D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.
   1. Bond to each device, box, or luminaire, unless otherwise indicated.
   2. Conductor insulation of the same rating as the phase conductors, for all feeders and branch circuits. Install the grounding conductors in the raceway with related phase and neutral conductors.
   3. Where parallel conductors in separate raceways occur, provide a grounding conductor in each raceway that meets requirements of NFPA 70.

B. Dry-Type Transformers: Install an insulated grounding conductor from the common point of connection of the transformer secondary neutral point and the transformer enclosure to the following:
   1. The nearest grounding electrode per NFPA 70, including but not limited to building steel where available.
   2. The grounding bus of the common electrode grounding system, located in the electrical equipment room.

C. Enclosures: Install an insulated grounding conductor from grounding bushings to the frame of the enclosure, ground bus, and equipment grounding strap where each occurs. Install grounding bushings on all raceways terminating within electrical enclosures constructed of separate enclosure panels, which are not integrally welded together.

D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-

mounted electrical devices operating at 120 V and more, including but not limited to air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4 (6-by-1000) grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

A. Provide permanent service neutral and equipment grounding in accordance with NFPA 70 and subject to the following additional requirements.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Comply with mounting and support requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Connect the service neutral and equipment ground to a common point within the metallic enclosure containing the main service disconnecting means. Equipment grounds and the identified neutral of the wiring system shall not be interconnected beyond this point in the interior wiring system. From the common point of connection of the service neutral and the equipment ground, run in non-magnetic conduit a grounding electrode conductor without joint or splice to the grounding electrode system and connect it with an approved bolted pressure clamp.

E. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
   4. Where expansion joints or telescoping joints occur, provide bonding jumpers.

G. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using

one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

H. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

I. Ground Rods: Drive rods until tops are 12 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor a minimum of 30-inches below grade unless otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods spaces at least two-rod lengths from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor. Refer to plans for details.

J. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
1. Test Wells: Install at least three test wells for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

K. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18m) apart.

L. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components as specified in Division 26 Section "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare certified test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum at service disconnect enclosure grounding terminal, at ground test wells, at individual ground rods and locations where a ground-resistance level is specified,. Make tests at ground rods before any conductors are connected.
a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
4. Tests for patient-care areas: In addition to the test listed above, perform additional field tests and inspections for patient care areas.
    a. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements. Perform the following tests:
        1) Impedance: Measurement shall be made between the reference point and the grounding contact of all receptacles in the patient care room. The maximum limit allowed is 0.1 ohms.
        2) Voltage: Measurement shall be made under no-fault conditions between a reference point and all exposed fixed electrical equipment with conductive surfaces in the patent care vicinity, including but not limited to: overbed wall- mounted fixtures, ceiling mounted exam lights, sensor faucets, etc. The maximum limit allowed is 20mV.
    b. Prepare certified test reports in compliance with NFPA 99 and submit reports in conjunction with field quality control reports required in Division 26 Section "Wiring Devices". Utilize the Patient Care Area Electrical Testing Form in the Appendix of this section for each patient care area.

B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
1. Report measured ground resistances that exceed the following values:
    a. Building's Grounding Triad: 2 ohms or less.
    b. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
    c. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
    d. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
    e. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
    f. Substations and Pad-Mounted Equipment: 5 ohms.
    g. Manhole/Handhole Grounds: 10 ohms.

C. Correct Deficiencies, Retest and Report:
1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace conductors, units, and rods as required to bring system into compliance.
2. Prepare a report, certified by testing agency, which identifies components checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Related Sections include the following:
   1. Division 26 Section 26 05 48 "Vibration and Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. RMC: Rigid metal conduit.

D. RAC: Rigid aluminum conduit.

E. RNC: Rigid nonmetallic conduit.

F. RSC: Rigid Steel conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, raceways using NFPA 70 criteria and performance requirements and design criteria indicated.
   1. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.
5. Concrete Based for Equipment.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. ABB Corporation
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.
2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Device Box Mounting Brackets and Stabilizer: Factory-fabricated sheet steel brackets for support of device boxes adjacent to or between studs.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper B-Line, Inc.; a division of Cooper Industries.
      b. ERICO International Corporation.

D. Through-Stud Cable and Raceway Support Clips: Factory-fabricated spring steel clip for cables or raceways where run horizontally through metal studs.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper B-Line, Inc.; a division of Cooper Industries.
      b. ERICO International Corporation.

E. Roof-mounted Raceway Support Blocking: Factory-fabricated support blocking for use under roof-mounted raceways. Wedge-shaped blocking constructed of 100% recycled UV-resistant Rubber with integral galvanized steel strut to accept raceway support clips.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper B-Line, Inc.; a division of Cooper Industries.
      b. ERICO International Corporation.

F. Tee Bar Grid Box Hanger: Factory-fabricated metal electrical box hanger for supporting boxes at locations between ceiling system t-grid components. Height adjustable for various electrical box depths. Attached to ceiling tee bar with screws or integral clamp for stability. Includes tab for independent support wire attachment.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper B-Line, Inc.; a division of Cooper Industries.
      b. ERICO International Corporation.

G. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

H. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

I. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

J. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in

hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1) Cooper B-Line, Inc.; a division of Cooper Industries.
   2) Empire Tool and Manufacturing Co., Inc.
   3) Hilti Inc.
   4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
   5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Horizontal and Vertical Support Spacing for Raceway(s): Space supports for EMT, IMC, and RMC as required by NFPA 70, but in no case less than listed below:
1. For raceways 1" diameter and larger, provide one hanger at 8'-0" on center.
2. For raceways less than 1" diameter, provide one hanger at 5'-0" on center.

C. Minimum Hanger Rod Size for Raceway Supports: Minimum rod size shall be 1/4 inch (6 mm) in diameter.

D. Single Raceways or Cables:
1. For Raceways 1-1/4-inch (32mm) and smaller: Install adjustable steel band hanger suspended on threaded rod.
2. For Raceways larger than 1-1/4-inch (30mm): Install trapeze-type supports fabricated with steel slotted support system suspended on threaded rods. Size trapeze members, including the suspension rods, based on the support required for the size, and loaded weight of the conduits.
   a. Secure raceway or cable to support with two-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with two-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

G. Corrosive Areas: Provide non-metallic slotted support systems for supports installed in corrosive areas. Corrosive areas include, but are not limited to the following:
   1. Pools and Pool Equipment Areas. (Rod shall be all threaded aluminum)
   2. Within 25-feet (7.62-m) of Cooling Towers and Air Cooled Chillers.

3.2 SUPPORT INSTALLATION

A. Comply with NFPA 70, NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT RMC EMT, RAC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Fasten junction, pull and devices boxes securely to the building construction, independent of raceway system.

D. Install Device Box Mounting Brackets supported between two studs. Do not attached Receptacle boxes directly to a single stud.

E. Install Through-Stud Cable and Raceway Support Clips where cables or raceways run horizontally through metal studs.

F. Support raceways at a distance above suspended ceilings to permit removal of ceiling panels and luminaires.

G. Locate raceways so as not to hinder access to mechanical equipment.

H. Do not secure conductors, raceways, or supports to suspended ceiling hanger rods or wires.

I. Install Tee Bar Grid Box Hanger supported between two ceiling grid tee bars where devices boxes are located flush in recessed suspended ceilings.
   1. Install at least one independent support rod from box hanger to structure.

J. Install Roof-mounted Raceway Support Blocking where raceways run on across roofing.
   1. Coordinate installation of roof supports with items specified in Division 07 Section "Roof Accessories." Provide products compatible with rooftop materials included in the Work.

K. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

L. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with

lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

M. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete." Bagged ready mix is not acceptable.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Section 09 91 23 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
   1. Refer to architectural for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
   2. "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
   3. "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. LFMC: Liquidtight flexible metal conduit.

D. RNC: Rigid nonmetallic conduit, underground only.

1.4 SUBMITTALS

A. Product Data: For surface raceways, floor boxes, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.

C. Coordination Drawings: Submit Coordination Drawings in accordance with Division 26 Section “Basic Electrical Requirements”. Include the following:
   1. Raceway routing plans, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
      a. Proposed cable pull points.
      b. Structural members in the paths of conduit groups with common supports.
      c. HVAC, plumbing items, and architectural features in the paths of conduit groups.
      d. Proposed splice locations.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70-Latest edition or edition enforced by state and local code authority.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.1 METAL WIREWAYS

A. Material and Construction: Sheet metal sized and shaped as indicated.
   1. Indoors: NEMA-1
   2. Indoors Pool Environment: NEMA-4X (Fiberglass)
   3. Outdoors: NEMA-3R Stainless Steel

B. Fittings and Accessories:

1. Include couplings, offsets, elbows, expansion joints, adapters, hold- down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2. Provide spring nuts or guards on all screws installed toward the inside to prevent wire insulation damage.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70 and UL 870.

D. Wireway Covers:
   1. Hinged type unless access restrictions require screw-cover type.
   2. Flanged-and-gasketed as required for NEMA type

E. Finish: Manufacturer's standard enamel finish.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Floor Boxes: Cast metal, fully adjustable, rectangular with four separate wiring compartments for power outlets, phone and data outlets as indicated on the drawing. The minimum size shall allow for devices, refer to drawings and provide larger boxes where indicated.
   1. Provide products by the following manufactures or submit prior approval for equals.
      a. Legrand Evolution EFB45
   2. Covers shall be UL Listed to U.S. and Canadian safety standards for tile, carpet, wood, bare concrete and terrazzo floors.
   3. Covers shall be selected by the architect.

B. Poke Thru Floor Boxes: Two hour rated poke thru floor unit with capabilities of four power receptacles and four communication outlets. The minimum size shall allow for four devices, refer to drawings and provide larger boxes where indicated. Provide power , data and phone outlets indicated on drawing.
   1. Provide products by the following manufactures or submit prior approval for equals.
      a. Legrand Wiremold 6AT
      b. Hubbell SystemOne
   2. Covers shall be selected by the architect.
   3. Poke thru floor boxes are to be utilized on upper floors unless noted otherwise. There must be accessibility in the space below the poke thru box.

C. Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum, type FD with gasketed cover.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

F. Cabinets:
   1. NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. metal barriers to separate wiring of different systems and voltage and
   5. Accessory feet where required for freestanding equipment.

G. In Grade Enclosures, Boxes And Covers:
   1. required to conform to all test provisions of the most current ANSI/SCTE 77 for Tier 22 applications.
   2. When multiple “Tiers” are specified the boxes must physically accommodate and structurally support compatible covers while possessing the highest Tier rating.
   3. All covers are required to have the Tier level rating embossed on the surface. In no assembly can the cover design load exceed the design load of the box.
   4. Cover to be labeled per use of box, ie “Electrical, Communications, etc”. Communications pull boxes shall be a minimum of 24"W X 36"L X 36 “D.

2.3 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime- coat finish ready for field painting.

2.4 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: Comply with ANSI C80.1 and UL 6; Galvanized rigid steel, each length with a coupling on one end and thread protector on opposite end.

B. Aluminum Rigid Conduit: Comply with ANSI C80.5 and UL 6A; Rigid aluminum, each length with a coupling on one end and thread protector on opposite end.

C. EMT and Fittings: ANSI C 80.3 and UL 797

D. FMC: Aluminum

E. LFMC: Comply with UL 360; Flexible steel conduit with neoprene jacket and copper grounding strand.

F. Fittings for RMC and RAC : Provide factory made threaded couplings of same material as the conduit.
   1. Molded thermoplastic insulating bushing at all boxes and cabinets, with locknuts inside and outside box or cabinet. In wet locations, provide watertight hubs for conduit entry into enclosures.
   2. Thermoplastic insulated grounding bushing on all conduits where grounding bushings are required, with locknuts inside and outside the enclosure. In wet locations provide watertight hubs for conduit entry into enclosures.

G. Fittings for EMT:
   1. Steel, set-screw or compression couplings.
   2. Steel, set-screw or compression insulated throat box connectors with molded thermoplastic insulating bushing at all boxes and cabinets, with locknuts inside box or cabinet.
   3. Steel, set-screw or compression insulated throat box connectors with thermoplastic

insulated grounding bushing on all tubing where grounding bushings are required.
4. Insulated throat material for fittings to be of a color that is easily distinguishable; clear thermoplastic throats are not acceptable.

H. Fittings for RMC and LFMC:
1. Adapters at connections between flexible and rigid conduit.
2. Thermoplastic insulated throat, steel connectors at box or cabinet terminations.
3. Insulated throat material for fittings to be of a color that is easily distinguishable; clear thermoplastic throats are not acceptable.

I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable:NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

J. Joint Compound for RMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:
1. Exposed: RAC,
2. Concealed: RMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Emergency Feeders: RAC
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures: NEMA 250, Type 3R, unless otherwise indicated.

B. Indoors:
1. Exposed, Not Subject to Physical Damage: EMT.Concealed: EMT.
2. Exposed and Subject to Physical Damage: RMC. Includes, but is not limited to, raceways in the following locations:
a. Loading dock
b. Areas used for traffic of mechanized carts, forklifts, and pallet-handling units.
3. Concealed within Masonry Walls: RMC
4. Concealed under Raised Floors: EMT or LFMC.
5. Elevator Pits: RAC, RMC, or LFMC.
6. Emergency feeders and branch circuits: EMT
7. Conductors over 600 volts: RMC.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
9. Damp or Wet Locations above Ground: RAC,
10. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

C. Minimum Raceway Size:
1. Branch Circuits:3/4-inch (21mm) trade size
2. Feeder Circuits: 3/4-inch (21mm)

D. Provide minimum 1/2-inch (16-mm) conduit for controls circuiting.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. RAC and RMC: Use threaded fittings, unless otherwise indicated.

F. Contractor to provide metal raceway in Patient Care Areas per 517.13. Raceway shall be installed as a redundant ground. Raceway shall be a considered a ground and an equipment grounding conductor shall be provided.

G. Magnetic Resonance Imaging (MRI) Environments: Provide aluminum raceways, boxes, supports and fittings within RF shielding. All fittings and supports in area shall be nonferrous.

H. Junction and Pull Boxes: Sheet steel boxes, unless noted or required otherwise.
1. Provide boxes no smaller than 4 inches square and 1-1/2 inches deep.
2. Size all junction and pull boxes in accordance with the NFPA 70, unless project conditions dictate use of larger boxes.

I. Outlet and Device Boxes: Sheet steel boxes, unless noted or required otherwise.
1. For Lighting Fixture Outlets: 4 inch square with raised fixture ring.
2. For Wall Switches, Receptacles, and Communication Use: 4 inch square, one-piece. Use boxes with plaster rings in all plastered walls where wall thickness permits. Use boxes less than 1-1/2 inch deep only in locations where deep boxes cannot be accommodated by construction.
3. Boxes Used Outdoors or in Damp/Wet Locations: Cast metal boxes with gasketed covers and threaded hubs.

3.2 INSTALLATION

A. Install raceways a minimum of 6-inches (150 mm) away from parallel runs of flues, steam pipes,hot-water pipes, and other objects operating at high temperatures

B. Install horizontal raceway runs above water and steam piping. Install raceways a minimum of 2-inch (50.8-mm) from pipe insulation.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in "Basic Electrical Requirements."

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Recessed Boxes in Fire-Rated Partitions: For boxes located on opposite sides of same partition do not install boxes back-to-back; separate boxes with a minimum of 24 inch separation

G. Recessed Boxes in partitions around Acoustically-Sensitive Spaces: For boxes located on opposite sides of same partition do not install boxes back-to-back; separate boxes with a minimum of 24 inch separation. Acoustically-Sensitive Spaces include, but are not limited to,the following:
1. Conference Rooms, Meeting rooms and similar spaces.
2. Classrooms, Training Rooms and similar spaces.
3. Interview Rooms, Consultation Rooms and similar spaces.
4. Auditoriums, Lecture Rooms, and similar spaces.
5. Ballrooms, Private Dining, and similar spaces.
6. Exam rooms, MRI rooms, and similar spaces.

H. Do not install aluminum conduits in contact with concrete.

I. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

J. Conceal conduit:
   1. EMT shall be installed within finished walls, ceilings, and floors, unless otherwise indicated.
   2. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
   3. On concealed conduit systems where boxes are not otherwise accessible, set boxes flush with finished surfaces for access, and provide overlapping covers.

K. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
   1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   2. Space raceways laterally to prevent voids in concrete.
   3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
   1. Run parallel or banked raceways together on common supports.
   2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

M. Join raceways with fittings designed and approved for that purpose and make joints tight.
   1. Use insulating bushings to protect conductors.

N. Terminations:
   1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
   2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

O. Stub-up Connections:
   1. Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor.
   2. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
   3. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

P. Flexible Conduit Connections:
   1. Use minimum of 72 inches at final connections to equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   2. Use LFMC in damp or wet locations subject to severe physical damage including mechanical equipment rooms, at motor or equipment locations at or near pumps, and when installed outdoors. Use LFMC in damp or wet locations not subject to severe physical damage.

Q. Install covers on junction boxes and conduit bodies after wiring and connections are completed.

R. Run conductors over 48 Volts in raceway, unless otherwise indicated.

S. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

T. Pull Boxes:
   1. Install no more than the equivalent of three 90-degree bends and a maximum of 150 feet between pull points in any conduit run except for communications conduits, for which fewer bends are allowed.
   2. Provide boxes where shown and where necessary for the installation and pulling of cables and wires.

U. Pull Wires:
   1. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength.
   2. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

V. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC by removing and replacing damaged portion of PVC with new.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
   2. Handholes and boxes.
   3. Manholes.

B. Related Sections include the following:
   1. Division 26 Section "Raceways and Boxes for Electrical Systems" for raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 DEFINITION

A. Duct: an underground raceway. This term may be used interchangeably with the term raceway.

B. Duct Bank: two or more raceways grouped together, irrespective of duct material or encasement material.

C. RMC: Rigid metal conduit.

D. RNC: Rigid nonmetallic conduit.

E. RSC: Rigid Steel conduit.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories for manholes, handholes, boxes, and other utility structures.
   4. Warning tape.
   5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans and elevations with dimensions and weights. Include sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and manhole frame support rings.
   4. Ladder details.
   5. Grounding details.
   6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Cover design.

3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

D. Coordination Drawings: Submit Coordination Drawings including:
1. Duct-Bank, Manhole, and Handhole plans, sections and elevation profiles; on which the following items are shown and coordinated with each other, based on input from installers of the items invlolved:
a. Duct banks included in the Work. Denote duct routing including bends and locations of expansion fittings. Include system profiles and elevations.
b. Other utilities, underground structures, architectural features, and topographic elements in the paths of duct banks. Denote system profiles and elevations.
c. Precast or Factory-Fabricated Underground Utility Structures.
d. Factory-Fabricated Handholes and Boxes.

E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Verify field measurements, routing and termination locations of duct bank prior to excavation for rough-in. Coordinate duct bank installation with underground Work and site Work and other site improvement Work specified in other Divisions.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Duct bank routing as indicated on the Drawings is the approximate location. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Engineer.

C. Accurately record actual routing of duct bank on Project record documents, and submit in accordance with Division 01.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND DUCTS

A. RMC: Comply with ANSI C80.1 and UL 6; Galvanized rigid steel, each length with a coupling on one end and thread protector on opposite end.

B. Fittings for RMC: Provide factory made threaded couplings of same material as the conduit.
1. Molded thermoplastic insulating bushing at all boxes and cabinets, with locknuts inside and outside box or cabinet. In wet locations, provide watertight hubs for conduit entry into enclosures.
2. Thermoplastic insulated grounding bushing on all conduits where grounding bushings are required, with locknuts inside and outside the enclosure. In wet locations provide watertight hubs for conduit entry into enclosures.

2.2 NONMETALLIC CONDUIT AND DUCTS

A. RNC: Comply with NEMA TC 2 and UL 651, type EPC-40-PVC or type EPC-80-PVC as indicated.

B. Fittings for RNC: Comply with NEMA TC 3 and UL 514B.; match to conduit or tubing type and material.

2.3 DUCT ACCESSORIES

A. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

B. Corrosion Resistance Tape for RSC: 20 mil polyvinyl chloride (PVC) tape with a high-tack adhesive and pipe primer to provide a corrosion- and impact-resistant seal.

C. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Christy Concrete Products.
2. Oldcastle Precast Group.
3. Riverton Concrete Products; a division of Cretex Companies, Inc.
4. Utility Concrete Products, LLC.
5. Hubbel

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering, selected to suit system or as otherwise required.
   a. "ELECTRIC-LV" for duct systems with power wires and cables operating at 600 V and less.
   b. "ELECTRIC-HV" for duct systems with power wires and cables operating over 600 V.
   c. "SIGNAL" for communications, data, and telephone duct systems.
4. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
   a. Extension shall provide increased depth as required.
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
6. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.
1. Color: Gray for paved areas and Green for landscaped areas, unless otherwise

indicated.

2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, selected to suit system or as otherwise required.
   a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables operating at 600 V and less.
   b. Legend: "ELECTRIC-HV" for duct systems with power wires and cables operating over 600 V.
   c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
6. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation.
   d. NewBasis.

2.6 UTILITY STRUCTURE ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Bilco Company (The).
2. Campbell Foundry Company.
3. Christy Concrete Products.
4. East Jordan Iron Works, Inc.
5. Neenah Foundry Company.
6. NewBasis.
7. Oldcastle Precast Group.
8. Osburn Associates, Inc.
9. Pennsylvania Insert Corporation.
10. Riverton Concrete Products; a division of Cretex Companies, Inc..
11. Strongwell Corporation; Lenoir City Division.
12. Underground Devices, Inc.
13. Utility Concrete Products, LLC.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B or cast aluminum with milled cover-to-frame bearing surfaces; diameter, 29 inches (737 mm).
   a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
2. Cover Legend: Cast in. Selected to suit system.
   a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
   b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.

c. Legend: "SIGNAL" for communications, data, and telephone duct systems.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
   a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.

C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.
   1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

D. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.

E. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
   1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

F. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-
inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.
   1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

H. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.
   1. Stanchions: T-section or channel; 2-1/4-inch (57-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.
   2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (460 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
   3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

I. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Capable of withstanding maximum hydrostatic pressures at the installation location with the ground-water level at grade.

PART 3 EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

System / Service	Voltage	Location	Duct Type & Standard	Encasement / Notes
Normal Power – Utility Service	>600 V	Outside building footprint	RNC, NEMA EPC-40 PVC	Direct-buried, with warning tape. Coordinate with utility (SLECA).
Normal Power – Services & Feeders	≤600 V	Outside building footprint	RNC, NEMA EB-20 PVC	Concrete-encased, with warning tape.
		Under building slab / structures	RNC, NEMA DB-20 PVC	Direct-buried with warning tape.
Normal Power – Branch Circuits	≤600 V	Outside building footprint	RNC, NEMA EPC-40 PVC	Direct-buried with warning tape.
		Under building slab (where permitted)		Direct-buried, 6” minimum below slab for floor boxes. NEC 300.5 restrictions apply.
Emergency / Essential Systems	≤600 V	Outside building footprint	RNC, NEMA EPC-40 PVC	Concrete-encased, with warning tape.
		Under building slab / structures	RNC, NEMA EPC-80 PVC	Direct-buried, with warning tape.
Emergency Branch Circuits	≤600 V	Outside building footprint	RNC, NEMA EPC-80 PVC	Direct-buried, with warning tape.
		Under building slab / structures		Direct-buried, with warning tape.
Communications / Signal	Low-voltage (≤600 V, telecom /data)	Outside building footprint	RNC, NEMA EPC-40 PVC	Direct-buried, with warning tape.
		Under building slab / structures		Direct-buried, with warning tape.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
   1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
   2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
   3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
   4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section 31 00 01 "Earth Moving", but do not use heavy- duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

D. Prepare excavation, base material installation, and compaction necessary for the specific ductbank arrangement.

E. Verify that excavation, base material installation, and compaction is completed.

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends:
   1. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations, unless otherwise indicated.

C. Install conduits to locate top of ductbank at depths as indicated or as required to coordinate with other portions of the Work.

D. Apply corrosion resistance tape and primer to direct-buried or concrete-encased RSC.

E. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell

without reducing duct line slope and without forming a trap in the line.

2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

G. Stub-Ups: Use manufactured rigid steel conduit elbows and rigid steel conduit extensions for stub-ups at poles, equipment, and at building entrances through the floor. Install insulated bushings on terminations.
1. Extend conduit extensions installed in floors a minimum of 4 inches (102 mm) above finished floor level.
2. Extend conduit extensions installed in equipment bases a minimum of 4 inches (102 mm) above finished base level.
3. Stub-Ups to Outdoor Equipment: For equipment mounted on outdoor concrete bases, Install insulated grounding bushings on terminations at equipment.

H. Sealing: Provide temporary caps to protect installed conduit against entrance of dirt and moisture prior to cable installation. Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

I. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

J. Concrete-Encased Duct(s) and Duct Banks:
1. Support duct(s) on duct separators.
2. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
3. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
4. Depth: Install top of duct bank at least 30 inches below finished grade in areas not subject to deliberate traffic, and at least 36 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
5. Stub-ups: Provide SCH 80 PVC conduit stub-ups.
6. Concrete Color: Dye added to concrete during batching or powder dye applied to top prior to curing.
   a. ELECTRIC: Red for duct systems with power wires and cables.
   b. SIGNAL: Orange for communications, data, and telephone duct systems.
7. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
   c. For Cast-In-Place manholes: Connect to manhole wall using dowels.
8. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment

unless specifically designed for duct-bank application.

9. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
11. Label top of encased duct bank with stenciled lettering 2-inch- (50-mm-) high letters at not less than 10-foot intervals, after curing. Label selected to suit system or as otherwise required.
    a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables operating at 600 V and less.
    b. Legend: "ELECTRIC-HV" for duct systems with power wires and cables operating over 600 V.
    c. Legend: "SIGNAL" for communications, data, and telephone duct systems.

K. Direct-Buried Duct(s) and Duct Banks:
1. Support duct(s) on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section 31 00 01 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
4. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving".
5. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
6. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
7. Set elevation of bottom of duct bank below the frost line.
8. Install manufactured PVC SCH 80 conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

L. Warning Tape: Bury Warning Tape Caps approximately 12 inches (300 mm) above ducts and duct banks, where indicated.
1. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank.
2. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.5 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

3. Unless otherwise indicated, support units on a minimum 6-inch (150-mm) level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade or as required to prevent floating of manhole.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below the frost line.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

E. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

F. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a minimum 4-inch (100-mm) level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and other non-concrete surfaces and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling,

and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section 03 30 00"Cast- in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Apply Sleeve and Sleeve Seal where raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, exterior walls, sub-grade walls or fire-rated floor and wall assemblies. Sleeve and Sleeve Seal materials and installation requirements are specified in Division 26 Section "Common Work Results for Electrical."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out- of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
   2. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. On completion of installation but before any equipment or cable is installed, inspect interior and exterior surfaces and perform the following:
   1. Clean ducts prior to cleaning manhole or pull box.
   2. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
   3. Remove all dirt and debris and pump out the manhole or pull box so that it is free of standing water. Manholes and pull boxes shall be dry prior to equipment or cable is installed.
   4. Clean internal surfaces of manholes, including sump and remove foreign material.
   5. Repair of damages resulting from construction after initial installation.
   6. Install ductile pipe plugs on each end of the raceways to prevent future debris from entering the raceways in the ducts.

END OF SECTION 26 05 43

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install items for identification of electrical products installed under Division 26.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.3 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes and standards. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.
   a. Typical:
      1) Type: Example – AC 60 Hertz
      2) Load: Example – Lighting and Power
      3) Voltage: Example – 120VA / 1 Phase
   b. As Required
      1) If more than one type of power is available in a conduit, then it shall be marked with the title “Electrical” on orange background.
      2) If used for control of HVAC conduit shall be marked with the title “Control” on an orange background
   c. Conduit that contains communication systems shall have the exact content and title on blue background.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm)wide; compounded for outdoor use.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm)thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Permanent Marker: Use of permanent marker in-lieu of the above is strictly prohibited.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENTHAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR ## INCHES." Verify work space required for specific project conditions with NFPA 70 and replace “##” in previous sentence with appropriate distance.
    i. Where panels are located in dedicated electrical rooms the floor shall be painted to indicated the clearance area.
3. Arc Flash Warning and Instructions: “WARNING – ARC FLASH AND SHOCK HAZARD. WEAR APPROPRIATE PPE. Determine appropriate protective clothing and personal protective equipment (PPE) for the task from NFPA 70E.

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

B. Engraved legend with black letters on white face.

C. Punched or drilled for mechanical fasteners.

D. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 ONE-LINE DIAGRAM NAMEPLATE

A. Preprinted engraved, laminated acrylic or melamine plastics sign. Nominal size, 12 by 12 inches (305 by 305 mm) by 1/8 inch (3.2 mm) thick. Engraved legend with black letters on white face. Image on sign depicting equipment components in single-line diagram format, using symbols and letter designations consistent with final one-line bus diagram. Produce a concise visual presentation of principal equipment components and connections.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch. Lettering and Background colors as indicated below:

System / Circuit Type	Label Letter Color	Background Color	Notes
Normal Power Circuits	White	Black	Applies to all normal distribution equipment and receptacles.
Emergency / Optional Standby Power	White	Purple	Distinct from life safety branch.
Life Safety Branch	White	Red	Applies to Panels and receptacles fed from Life Safety.
Fire Alarm System	Black	Red	Applies to FACP, annunciators, initiating and notification circuits.
Fire Suppression Supervisory & Control	Yellow	Red	Sprinkler, clean agent, or suppression monitoring.
Combined Fire Alarm & Security	Blue	Red	Only if systems are combined in panels or circuits.
Security System	Blue	Yellow	Access control, intrusion detection, cameras.
Mechanical / Electrical Supervisory (BAS)	Green	White	Building automation and monitoring systems.
Telecommunications	Blue	White	Structured cabling, data, voice. (Coordinate with Division 27).
Control Wiring	Green	White	HVAC and other control circuits.
Nurse Call	White	Blue	Applies to head-end equipment and devices.
Public Address / Intercom	White	Black	Paging/intercom amplifiers and speakers.
CATV / MATV	White	Black	Television distribution systems.
Clock System	White	Black	Central or master clock controls.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties : Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch (5 mm)
   2. Tensile Strength: 50 lb (22.6 kg), minimum
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 09 painting Section 09 91 23.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 APPLICATION

A. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

B. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Main-Tie-Main Switchboards
      c. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
   3. Arc Flash Warning Labels: Apply label to door or cover at all access point of equipment including, but not limited to, the following:
      a. Disconnect switches
      b. Electrical switchgear and switchboards
      c. Enclosed circuit breakers
      d. Motor starters
      e. Panelboards
      f. Power transfer equipment (ATS/MTS)
      g. Transformers

F. Junction Boxes and Pull Boxes: Identify voltage, source, and circuit number(s) on cover of pull and junction boxes with hand-written legible block lettering using black permanent marking pen.

G. Instruction Signs:
1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operating Instructions: Install instruction signs with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer load shedding, Kirk Key Controlled Breakers.

H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. This applies to existing equipment that is modified during this project. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
2. Equipment to Be Labeled Shall Include But Not Be Limited To:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Transformers.
   e. Emergency system boxes and enclosures.
   f. Disconnect switches.
   g. Enclosed circuit breakers.
   h. Power transfer equipment. (ATS/MTS)
   i. Contactors.
   j. Motor Starters
   k. Fire-alarm control panel and annunciators
   l. Power-generating units.
   m. All junction boxes. Label to include circuit numbers (panel and number).
   n. All receptacle device plates shall be etched with circuit numbers. (panel and number).
   o. All lighting switch plates shall have circuit numbers on the back of the plate. (panel and number).

Examples:

NORMAL 'HA' 480Y/277V FED FROM 'MDP'	EMERGENCY SYSTEM 'ATS-LS' 480Y/277V FED FROM 'MDP' NORMAL FED FROM 'EMSB' EMERGENCY	NORMAL 'T-LA' 75KVA, 480V to 208Y/120V FED FROM 'HA' FEEDS 'LA'

	FEEDS 'LS-HA'	

3. Provide for each feeder overcurrent protective device in each switchgear, switchboard, distribution panelboard, motor control center, and any other similar equipment furnished under this Division, identification as to the specific load that it serves.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   1. Color shall be factory applied or for sizes larger than No. 1 AWG, if authorities having jurisdiction permit, field applied.
   2. Colors for Grounding Conductors:
      a. Equipment Grounding Conductor: Green.
      b. Isolated Equipment Grounding Conductor: Green with Yellow Stripe.
   3. Colors for 208/120-V Wye Systems:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Grounded Conductor (Neutral): White
   4. Colors for 480/277-V Wye Systems:
      a. Phase A: Brown.
      b. Phase B: Purple.
      c. Phase C: Yellow.
      d. Grounded Conductor (Neutral): white
   5. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common

trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Section 09 91 23.

END OF SECTION 26 05 53

SECTION 26 25 60 – DUAL PURPOSE TRANSFER SWITCH DOCKING STATION

PART 1 GENERAL

1.1 GENERAL

A. Dual Purpose Quick Connect Power panels shall provide a convenient, reliable, and economical way to connect temporary emergency power from portable generators to a facility in conjunction with a transfer switch or shall provide a convenient way to connect load banks to a facility.

B. Dual Purpose Quick Connect power panels shall include two sets of 16 Series Camlocks (Male and Female).
   1. Female camlocks shall be enclosed behind a pad-lockable door.
   2. Male camlocks shall be enclosed behind a trap key interlocked door.

C. Quick Connect Power Panels shall be TRYSTAR or ASCO 300 Series. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid. Alternate bids must list any deviations from this specification.

D. Dual Purpose Quick Connect Panels are not designed for the simultaneous operation of both Input and Output Connections.
   1. Castell™ or Kirk Key™ locks must be installed on outer door housing male quick connects and permanent generator breaker which serves as an interlock between the permanent generator and portable generator.

1.2 ENCLOSURE

A. The dual-purpose quick-connect power panel shall be a pad mount enclosure manufactured of aluminum and painted ANSI 61 gray.

B. All dual purpose quick-connect power panels shall be Type 3R compliant. The Type 3R rating shall be maintained with the temporary cables installed.

C. Cables shall enter and exit the wiring chamber via access holes specifically designed for conductors and shall be provided with a bushing or shall be formed so that there are no sharp edges with which conductor insulation may come in contact.

D. Connections shall be arranged so that cables drape downward when connected.

E. The dual-purpose quick connect panel shall be able to accommodate side, and bottom cable entry.

F. Multiple Chamber style designed to isolate permanent connections and camlock connections.

G. The quick-connect panel shall be divided into an upper termination chamber and a lower wiring chamber.
   1. The upper termination chamber shall consist of:
      a. Female 16 series single pole connectors with flip covers.
      b. Load Dump Receptacle
      c. Pad-lockable door preventing access to hot temporary load bank connections while the unit is in use.
   2. The lower chamber shall have:
      a. 45 degree recessed male 16 series single pole connectors for hassle-free connection eliminating stress on cables during operation
      b. Pad-lockable tamper-resistant door with trap door preventing access to temporary connections while the unit is in use.

c. Trap door for cable egress.
d. Castell ™ Lock and key (kirk key compatible) mounted on the exterior trap door. Restricts access to Portable generator connection unless the key is captive Permanent Generator Breaker is open.
e. Slotted fingers to restrict cable access reducing theft.
f. Phase Rotation Relay
g. 2- Wire Auto Start Terminals
h. Auto Start Destination Switch

3. The quick-connect panel shall have two outer hinged access doors restricting access to both chambers for safety and security.
4. The outer access doors shall have a padlock hasp preventing unauthorized entry.

1.3 ELECTRICAL

A. The dual-purpose quick connect panel shall have input and output connections rated up to 600 VAC.

B. Input and Output connectors share a common 100 kA Plated Copper Smart T-Slotted Buss.

C. All electrical connectors shall be cam-type single pole connectors compatible with Marinco or Leviton 16 Series CAM Locks™ and available color-coded as per industry standard practice:
1. 240V and below: phase 1 = black, phase 2 = red, phase 3 = blue (if required).
2. 440 to 480V: phase 1 = brown, phase 2 = orange, phase 3 = yellow.
3. Ground shall always be green.
4. Neutral shall always be white.
5. A minimum of 25% ground shall be provided.
6. Lug size and quantity as indicated on outline drawings.
7. Input and Output connections share a common bus, Castell Lock provided, or Kirk Key compatible Lock must be used as a mechanical interlock with the Permanent Generator breaker.

D. The upper termination chamber shall be provided with lug terminals for the permanently installed conductors.

E. The front of the panel shall have the cam-type single pole connectors as specified above:
1. For 1200A, there shall be three rows of up to 4 female single-pole connections (no neutral) for Load Bank connections and three rows of up to 5 female single-pole connections for portable generator connections.

F. Withstand Current Rating (WCR) shall be no less than 100kA verified by testing supervised by a Nationally Recognized Testing Laboratory, not by calculation.

1.4 STANDARD ACCESSORIES

A. Schneider Electric Phase Rotation Monitor with fuses

B. Auto start Banana Terminal Post

C. Auto Start Destination Toggle Switch

D. Load Dump Receptacle (L1-15R 15A 125V Twist Lock receptacle)

1.5 COMPLIANCE

A. Dual Purpose Quick Connect Panels shall bare UL 891 markings.

B. The 800 - 4000 Amp Dual Purpose Quick Connect Panel must be listed to UL 891 for Panelboards.

C. “Built to the standard” shall not be allowed: the quick connect panels shall be tested in accordance with and listed to UL 1008 & UL 891 standards.

D. UL 50 Listed enclosures may be used but only listed to UL 50 shall not be acceptable.

E. Comply with NFPA 70.

1.6 WARRANTY AND SERVICE

A. The Dual Purpose Quick Connect Panel shall come with a warranty of no less than 24 months from the date of shipment.

B. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

END OF SECTION 26 25 60

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Short-circuit study input data, including completed computer program input data sheets.
   2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
      b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist and Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. SKM Systems Analysis, Inc.
   2. ETAP
   3. Easy Power

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings/ and impedance
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short-circuit ratings.
   2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
   3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:
      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.
1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Engineer.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
4. Obtain all arc flash information from the local utility in a timely manner. No extension of the contract time shall be permitted due to coordination with the local utility.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the

engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
   2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
   1. Electric utility's supply termination point.
   2. Incoming switchgear.
   3. Unit substation primary and secondary terminals.
   4. Low-voltage switchgear.
   5. Motor-control centers.

6. Control panels.
7. Standby generators and automatic transfer switches.
8. Branch circuit panelboards.
9. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 26 05 72

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and equipment evaluation reports.
   3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist and Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. The following parts from the Protective Device Coordination Study Report:
         1) One-line diagram.
         2) Protective device coordination study.
         3) Time-current coordination curves.
      b. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. SKM Systems Analysis, Inc.
      b. ETAP

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
   1. Optional Features:
      a. Arcing faults.
      b. Simultaneous faults.
      c. Explicit negative sequence.
      d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

E. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
      c. Fuses: Show current rating, voltage, and class.

F. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
   1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
   2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
   3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
   4. Plot the following listed characteristic curves, as applicable:
      a. Power utility's overcurrent protective device.
      b. Medium-voltage equipment overcurrent relays.
      c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
      d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
      e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
      f. Cables and conductors damage curves.
      g. Ground-fault protective devices.
      h. Motor-starting characteristics and motor damage points.

i. Generator short-circuit decrement curve and generator damage point.
j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:
1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
   1. Electric utility's supply termination point.
   2. Switchgear.
   3. Unit substation primary and secondary terminals.
   4. Low-voltage switchgear.
   5. Motor-control centers.
   6. Standby generators and automatic transfer switches.
   7. Branch circuit panelboards.

M. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short-circuit ratings.
   2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3.3 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
   1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
   2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
   3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.4 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141 and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

3.5 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Engineer.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Electrical power utility impedance at the service.
   3. Power sources and ties.
   4. Short-circuit current at each system bus, three phase and line-to-ground.
   5. Full-load current of all loads.
   6. Voltage level at each bus.
   7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
   10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
   12. Maximum demands from service meters.
   13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   14. Motor horsepower and NEMA MG 1 code letter designation.
   15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
   16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
   17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
      a. Special load considerations, including starting inrush currents and frequent starting and stopping.
      b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
      c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
      d. Generator thermal-damage curve.
      e. Ratings, types, and settings of utility company's overcurrent protective devices.
      f. Special overcurrent protective device settings or types stipulated by utility company.

g. Time-current-characteristic curves of devices indicated to be coordinated.
h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:
1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 26 05 73

SECTION 26 05 74 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist and Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. SKM Systems Analysis, Inc.
      b. ETAP
      c. Easy power

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Short-Circuit Study Output: As specified in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

E. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

F. Arc-Flash Study Output:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis

G. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude with and without required Arc Energy Reduction methods.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc-flash boundary.
   5. Working distance.
   6. Incident energy.
   7. Hazard risk category.
   8. Recommendations for arc-flash energy reduction.

H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
   1. Location designation.
   2. Nominal voltage.
   3. Flash protection boundary.
   4. Hazard risk category.
   5. Incident energy.
   6. Working distance.
   7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:
1. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.
1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the one-line diagram on. Call discrepancies to the attention of Engineer.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 26 05 74

SECTION 26 08 10 - ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The purpose of this section is to specify Division 26 responsibilities in the commissioning process which are being directed by the CxA. Other electrical system testing is required under the direction of the GC.

B. The list of commissioned equipment and systems is found in Section 01 91 13.1.7.

C. Commissioning requires the participation of Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Division 01 91 13. Division 26 shall be familiar with all parts of Division 01 91 13 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2 RESPONSIBILITIES

A. Electrical Contractors. The commissioning responsibilities applicable to the electrical contractor are as follows *(all references apply to commissioned equipment only)*:

Construction and Acceptance Phases

1. Include the cost of commissioning in the contract price.

2. In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

3. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.

4. Contractors shall provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment.

5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.

   a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

   b. The Commissioning Agent may request further documentation necessary for the commissioning process.

   c. This data request may be made prior to normal submittals.

6. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review and approval.

7. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

8. Provide assistance to the CxA in preparation of the specific functional performance test procedures specified in Section 260811. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

9. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the CxA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CxA for review.

10. During the startup and initial checkout process, execute and document the electrical-related portions of the pre-functional checklists provided by the CxA for all commissioned equipment.

11. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

12. Address current A/E punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.

13. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

14. Perform functional performance testing under the direction of the CxA for specified equipment in Section 260811 and 01 91 13. Assist the CxA in interpreting the monitoring data, as necessary.

15. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, PM and A/E and retest the equipment.

16. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

17. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.

18. Provide training of the Owner's operating personnel as specified.

19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Electrical Designer/Engineer

1. Refer to Section 01 91 13 for the responsibilities of the Electrical Designer/Engineer.

1.3 RELATED WORK

A. Refer to Section 01 91 13, Part 1.4 for a listing of all sections where commissioning requirements are found.

B. Refer to Section 01 91 13 Part 1.7 for systems to be commissioned and section 01 91 13 Part 1.6 and 260811 for functional testing requirements.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Division 26 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 01 91 13 Part 2.1 for additional Division 16 requirements.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Division 26 shall provide submittal documentation relative to commissioning to the CxA as requested by the CxA. Refer to Section 01 91 13 Part 3.3 for additional Division 26 requirements.

3.2 STARTUP

A. The electrical contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 91 13 Part 3.4. Division 16 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and CM. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.3 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 91 13 Part 1.7 for a list of systems to be commissioned and to Part 3.6 for a description of the process and to Section 260811 for specific details on the required functional performance tests.

3.4 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Refer to Section 01 91 13 Part 3.4 for specific details on non-conformance issues relating to pre-functional checklists and tests.

B. Refer to Section 01 91 13 Part 3.6 for issues relating to functional performance tests.

3.5 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. Division 26 shall compile and prepare documentation for all equipment and systems covered in Division 26 and deliver to the GC for inclusion in the O&M manuals, according to Section 01 78 24.

B. The CA shall receive a copy of the O&M manuals for review.

3.6 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01 91 13 for additional details.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 01 91 13 for additional details.

C. Electrical Contractor. The electrical contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01 91 13, Part 3.9.

2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.

3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, power failure, etc.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

7. Training shall include:

a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.

b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

c. Discuss relevant health and safety issues and concerns.

d. Discuss warranties and guarantees.

e. Cover common troubleshooting problems and solutions.

f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.

g. Discuss any peculiarities of equipment installation or operation.

h. The format and training agenda in *Guidelines for Commissioning HVAC Systems*, ASHRAE, 1989R, 1996 is recommended.

i. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

9. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.

10. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

11. Duration of Training. The electrical contractor shall provide training on each piece of equipment according to the following schedule.

__1___ Lighting Controls

3.7 DEFERRED TESTING

A. Refer to Section 01 91 13, Part 3.10 for requirements of deferred testing.

3.8 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 01 91 13 and the filled out startup, initial checkout and pre-functional checklists.

END OF SECTION

SECTION 26 08 11 - ELECTRICAL TESTING REQUIREMENTS

PART 1 - GENERAL

1.1 INCLUDED SYSTEMS AND EQUIPMENT

A. The following is a list of the equipment and system test requirements included in this section:

1. Electrical System Power Quality
2. Lighting Controls and Lighting
3. Emergency Power Systems
4. Fire Alarm System

1.2 DESCRIPTION

A. This section specifies the functional testing requirements for Division 26 systems and equipment. From these requirements, the Commissioning Authority (CxA) shall develop step-by-step procedures to be executed by the Subs. The general functional testing process, requirements and testing methods definitions are described in Section 01 91 13. The test requirements for each piece of equipment or system contain the following:

1. The contractors responsible to execute the tests, under the direction of the CxA.
2. A list of the integral components being tested.
3. Pre-functional checklists associated with the components.
4. Functions and modes to be tested.
5. Required conditions of the test for each mode.
6. Special procedures.
7. Required methods of testing.
8. Required monitoring.
9. Acceptance criteria.
10. Sampling strategies allowed.

1.3 PREREQUISITES

The following applicable generic prerequisite checklist items are required to be listed on each written functional test form and be completed and checked off by CxA prior to functional testing.

__ All related equipment has been started up and start-up reports and pre-functional checklists submitted and approved ready for functional testing:

__ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

_____ _____

Controls Contractor Signature or Verbal Date

__ All A/E punchlist items for this equipment corrected.

__ These functional test procedures reviewed and approved by installing contractor.

__ Safeties and operating ranges reviewed by the CxA.

__ Test requirements and sequences of operation attached.

__ Schedules and setpoints attached.

__ Sufficient clearance around equipment for servicing.

__ Record of all values for pre-test setpoints changed to accommodate testing has been made and a check box provided to verify return to original values (control parameters, limits, delays, lockouts, schedules, etc.).

__ Other miscellaneous checks of the pre-functional checklist and start-up reports completed successfully.

1.4 MONITORING

A. Monitoring is a method of testing as a stand-alone method or to augment manual testing.

B. All points listed in the required monitoring section of the test requirements which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CA using dataloggers. At the option of the CxA, some control system monitoring may be replaced with datalogger monitoring. At the CxA's request, the controls contractor shall trend up to 20% more points than listed at no extra charge.

C. Hard copies of monitored data must be in columnar format with time down the left column and at least 4 columns of point values on the same page. Graphical output is a desirable option, if the system can produce it.

PART 2 - PRODUCTS

-- NOT APPLICABLE --

PART 3 - EXECUTION

1. ELECTRICAL POWER SYSTEM

A. Parties Responsible to Execute Functional Test
1. Electrical contractor: assist in testing sequences
2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
1. Switchgear
2. Transformers
3. Panelboards

C. Prerequisites The applicable prerequisite checklist items listed in the beginning of Section 26 08 11 shall be listed on each functional test form and checked off prior to functional testing.

D. Functions / Modes Required To Be Tested and Test Methods
The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	**Test Method Manual (demonstration), Monitoring, Either or Both**
MISCELLANEOUS FUNCTIONS	
1. All specified functions and features are set up, debugged and fully operable.	Verbal discussion of features
2. Test Meter Readings	Demonstration

E. Special Procedures (other equipment to test with, etc.; reference to function ID)
None

F. Required Monitoring
1. None required, though monitoring can substitute for manual testing for all functions. See section 1.4 above.

G. Acceptance Criteria (referenced by function or mode ID)
1-2 For the conditions, sequences and modes tested, related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

H. Sampling Strategy for Identical Units
1. All will be tested.

END OF REQUIREMENTS FOR ELECTRICAL POWER QUALITY TEST

2. LIGHTING CONTROLS AND LIGHTING

A. Parties Responsible to Execute Functional Test
1. Electrical contractor: assist in testing sequences
2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
1. Lighting

C. Prerequisites The applicable prerequisite checklist items listed in the beginning of Section 26 08 11 shall be listed on each functional test form and checked off prior to functional testing.

D. Functions / Modes Required To Be Tested and Test Methods
The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	**Test Method Manual (demonstration), Monitoring, Either or Both**
MISCELLANEOUS FUNCTIONS	
1. All specified functions and features are set up, debugged and fully operable.	Verbal discussion of features
2. Test Meter Readings	Demonstration

E. Special Procedures (other equipment to test with, etc.; reference to function ID)
None

F. Required Monitoring
1. None required, though monitoring can substitute for manual testing for all functions. See section 1.4 above.

G. Acceptance Criteria (referenced by function or mode ID)
1-2 For the conditions, sequences and modes tested, related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

H. Sampling Strategy for Identical Units
1. All will be tested.

END OF REQUIREMENTS FOR LIGHTING CONTROLS

3. EMERGENCY GENERATOR & ATS

A. Parties Responsible to Execute Functional Test
1. Electrical contractor: assist in testing sequences
2. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested
1. ATS

C. Prerequisites The applicable prerequisite checklist items listed in the beginning of Section 16997 shall be listed on each functional test form and checked off prior to functional testing.

D. Functions / Modes Required To Be Tested and Test Methods
The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	**Test Method Manual (demonstration), Monitoring, Either or Both**
MISCELLANEOUS FUNCTIONS	
1. All specified functions and features are set up, debugged and fully operable.	Verbal discussion of features
2. Full load test.	Demonstration
3. Remote Monitoring	Demonstration
4. Override Mode	Demonstration
5. Weekly Exercise	Demonstration

E. Special Procedures (other equipment to test with, etc.; reference to function ID)
None

F. Required Monitoring
1. None required, though monitoring can substitute for manual testing for all functions. See section 1.4 above.

G. Acceptance Criteria (referenced by function or mode ID)
1-3 For the conditions, sequences and modes tested, related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

H. Sampling Strategy for Identical Units
1. All will be tested.

END OF REQUIREMENTS FOR EMERGENCY GENERATOR

4. FIRE ALARM

This is a performance test to verify that the fire alarm system can perform as specified.

A. Parties Responsible to Execute Functional Test
   1. Electrical contractor: provide all testing instruments and test sequences and debugging
   2. Fire alarm system contractor, local and remote monitoring site
   3. CxA to witness, direct and document testing

B. Integral Components or Related Equipment Being Tested
   Fire Suppression

C. Prerequisites: The applicable prerequisite checklist items listed in the beginning of Section 26 08 11 shall be listed on each functional test form and checked off prior to functional testing.

D. Required Monitoring
   None

E. Acceptance Criteria
   As required by Fire Marshall.

F. Sampling Strategy
   As required by Fire Marshall.

END OF REQUIREMENTS FOR FIRE ALARM SYSTEM TEST

END OF SECTION

SECTION 26 08 12 - ELECTRICAL PRE-FUNCTIONAL CHECKLISTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section contains representative Pre-functional Checklists in a form format (PC).

1. The checklists contain items for both Division 26 contractors to perform. On each checklist, a column is provided that should be filled out by the Contractor assigning responsibility for that line item to a trade.

2. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.

3. Refer to Section 01 91 13 for additional requirements regarding pre-functional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigor and clarity shall be used. Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

Pre-functional Electrical Checklist

Project : SAMPLE

PF-01 ELECTRICAL POWER SYSTEM

Components included: PANELBOARDS, SWITCHBOARD

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This pre-functional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ___ List attached.

_____	_____	_____	_____
Electrical Contractor	Date	General Contractor	Date

Pre-functional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

2. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check **Equip Tag->**						**Contr.**
Permanent labels affixed						
Compare equipment nameplate and data with drawings and specs.						
Operate circuit breaker to insure smooth operation.						
Maintenance access acceptable for NEC compliance						
Perform a contact/pole resistance test.						
Determine ground fault pickup and time delay by primary current injection.						
Inspect main and branches for cracks or defects						
Verify any adjustable settings are in accordance with coordination survey						
Verify that proper bushings are installed						
Verify wire sizes, panel clean and circuit directory accurate						
Torque all lugs to factory settings						

- *The checklist items of Part 4 are all successfully completed for given trade.....___ YES ___ NO*

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

-- END OF PROCEDURES --

END OF SECTION

SECTION 26 08 13 - ELECTRICAL FUNCTIONAL TEST PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section contains sample Functional performance Test procedures in a form format (FT).

1. The sample FT procedures displayed in a form format here are intended to provide the Subs and CA with an example of a format and an indication of the rigor of the required testing and documentation for various equipment types. They were not developed for this project. Other forms and formats are acceptable if they comply with the rigor, clarity and intent of all the commissioning specifications. The CA will use the functional testing requirements in Sections 26 08 11 and the testing protocols specified in Section 01 91 13 for developing site-specific functional test procedures and forms for this project. For illustrative purposes, sequences of operation associated with a few pieces of the equipment for which tests are included are also provided.

Functional Test

Project: Sample

EFT-01 INTERIOR LIGHTING CONTROLS – OCCUPANCY SENSORS

1. Participants

Party		Participation
Thompson Building Energy Solutions		

Party filling out this form and witnessing testing _____
Date of test _____

2. Prerequisite Checklist

a. _X_ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints, schedules, debugging and fine tuning of occupancy sensor parameters.
b. _X_ All A/E punchlist items for this equipment corrected.
c. _X_ Safeties and operating ranges reviewed.
d. _X_ Test requirements and sequences of operation attached.
e. _X_ Schedules and setpoints attached.
f. _X_ Schedule of fixtures on each control type has been reviewed.
g. _X_ Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays, Lockouts, Schedules, Etc. Changed to Accommodate Testing:

3. Sensor Calibration Checks. Check the sensors listed below for calibration and adequate location.

4. Device Calibration Checks.

5. Verification of Misc. Pre-functional Checks.

Misc. site checks of the pre-functional checklist and startup reports completed successfully. Pass? Y / N

_____

_X_ Occupancy sensor in the correct location.

_X_ Occupancy sensor mounted securely.

Functional Testing Record – Interior Occupancy Sensors

Proced. No.	Rm No.	Test Procedure (including special conditions)	Expected and Actual Response [Write ACTUAL response in brackets or circle]	Pass Y/N & Note #
1		Walk into room with lights off. Note: All occupancy sensor timing should be set for 15minutes.	Lights should turn on.	
2		Exit the room	Lights should stay on.	
3		Wait 15 minutes	Lighting should turn off after 15 minutes.	

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ _____ _____ _____

Commissioning Agent Date Owner's Representative Date

-- END OF TEST –

END OF SECTION

SECTION 26 09 13 - ELECTRICAL POWER MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical power management system (EPMS) and associated hardware, software, and services.

1.2 ABBREVIATIONS AND ACRONYMS

A. PQ: Power quality.

B. PTP: Precision time protocol.

1.3 DEFINITIONS

A. Electrical power management system may also be identified as EPMS, EMS, PEMS, energy management system, electrical power monitoring system, power and energy monitoring system, or energy and power management system.

B. Precision Time Protocol: Protocol for accurate and precise network synchronization of clocks, complying with IEEE 1588.

C. Smart Mobile Device: Smart phone or tablet compatible with iOS or Android OS capable of running apps used for specified functionality.

1.4 REFERENCE STANDARDS

A. BS EN 50160 - Voltage Characteristics of Electricity Supplied by Public Electricity Networks; 2010, with Amendments (2019).

B. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

C. ISO 50001 - Energy Management Systems – Requirements with Guidance for Use; 2018.

D. ISO 50002 - Energy Audits – Requirements with Guidance for Use; 2014.

E. ISO 50006 - Energy Management Systems – Measuring Energy Performance Using Energy Baselines (EnB) and Energy Performance Indicators (EnPI) – General Principles and Guidance; 2014.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 99 - Health Care Facilities Code; 2024, with Errata.

I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work to provide EPMS-compatible equipment and systems with sensors, interfaces, and other appurtenances required for specified functionality.

B. Software Configuration Review Meetings:
1. Review proposed screens and report formats with Owner and Engineer throughout configuration process.

2. Convene minimum of two meetings at Owner's facilities, one for initial review and one at approximately 50 percent completion. EPMS supplier's programming personnel to attend initial review meeting.

C. Preinstallation Meeting: Review material selections and installation procedures with manufacturer's representative and affected installers.

D. Scheduling: Where source interruptions are required for testing and commissioning, arrange scheduling with Owner; allow minimum of one day for pretesting and one day for acceptance testing, with accommodations for testing outside of normal business hours where applicable.

1.6 SUBMITTALS

A. Provide sufficient information to determine compliance with contract documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.

B. Indicate deviations from contract documents with reference to corresponding drawing or specification number and written justification for deviation.

C. Software Configuration Standards and Conventions:
1. EPMS supplier to document decisions made during first EPMS software configuration review meeting.
2. Provide color documents for accuracy, using accurately depicted colors and shapes proposed for use in final system; black and white documents are not acceptable.
3. Include the following for review and approval before software configuration commences:
   a. Intelligent Building Management System (iBMS) Integration:
      1) Energy metering points list with associated metadata tags indicating location and load type.
      2) Electrical quantities for each metering point, including but not limited to, energy per phase, real power per phase, apparent power per phase, reactive power per phase, current per phase, voltage, power factor.
   b. High Accuracy and Resolution Event Recording: Implementation details, including critical status points and time synchronization mechanism.
   c. Capacity Management: Circuits for reporting, report formats, and dashboard layouts.
   d. Backup Power Testing: Mechanisms of integration with generator system, report formats, and dashboard layouts.
   e. Asset Performance: Circuits for LV breaker aging monitoring, report formats, and dashboard layouts.
   f. Utility Bill Verification: Billing determinants and billing report formats.
   g. Cost Allocation: Energy cost determinants, report formats, and dashboard layouts.
   h. Energy Usage and Benchmarking:
      1) Energy usage determinants.
      2) Report formats and dashboard layouts.
      3) Data import mechanisms to integrate normalization data from external systems, such as building management systems and production systems.
      4) Data import mechanisms to integrate operating state information from external systems, such as HVAC and production systems.
   i. Energy Performance Analysis and Verification (Modeling):
      1) Energy usage determinants.
      2) Report formats and dashboard layouts.
      3) Data import mechanisms to integrate relevant energy driver information, such as temperature and occupancy.

D. Product Data: Provide manufacturer's standard catalog pages and data sheets, including physical data, electrical performance, electrical characteristics, and connection requirements.

E. Shop Drawings:
1. Provide elementary and interconnection diagrams for field-monitoring devices and networking components, including power, signal, control, and communications wiring with network addresses.
2. Identify network connections, protocols, device room locations, and recommended installation notations.
3. EPMS-Connected LV Switchgear: Provide project-specific drawings for each switchgear/breaker.

F. Commissioning Report: Provide detailed scope of work checklist document with delivered functionality listed and checked.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. EPMS services contract.

J. Operation and Maintenance Data: Include sequence of operation (for control applications such as automatic transfer schemes and load control), layout drawings, bill of material, spare parts list, and component catalog information.

K. Project Record Documents:
1. Construction, installation, schematic, and wiring diagrams updated to as-installed and commissioned state.
2. Configured settings/parameters for adjustable components updated to as-installed and commissioned state, noted if different from factory default.

L. Software: Copy of software required in this section, associated licensing documentation, and support contact information. Indicate licensing in Owner's name.

M. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
1. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain EPMS components.
a. Equipment Configuration Software: PC-based or smart mobile device application; provide one of each different communication interface cable required to connect computer/device for configuration and programming.
b. Electronic Configuration Files: For future upload into replaced/repaired components, in media format acceptable by Owner.

1.7 QUALITY ASSURANCE

A. Comply with the following:
1. NFPA 70.
2. Requirements of local authorities having jurisdiction.
3. Applicable local codes.

B. Manufacturer Qualifications:
1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 10 years.
2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.

C. Installer Qualifications: Firm with minimum 10 years experience with EPMS of similar type and scope.

D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

E. Design Tests:
1. Test EPMS in test-bed environment with hardware devices representative of large-scale functional power distribution system, including both physical and simulated devices, such as advanced power quality meters, low-voltage main meters, low-voltage feeder meters, circuit breaker trip units, transformer monitoring units, protective relays, and branch circuit power meters.
2. Publish documented test results, including system response times, network performance, and recommended network architectures, available upon request.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.

D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.9 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Schneider Electric; Square D EcoStruxure Power

B. Source Limitations: Furnish products produced by same manufacturer as electrical distribution equipment for project and obtained from single supplier.

2.2 ELECTRICAL POWER MANAGEMENT SYSTEM (EPMS) - GENERAL REQUIREMENTS

A. Basis of Design: Schneider Electric; Square D EcoStruxure Power

B. Provide data and analytics functionality for energy performance optimization, power reliability/availability, and sustainability metrics. Provide features, including but not limited to, real-time monitoring, alarming/event management, energy, power, and sustainability data analytics/visualization to facilitate the following functions:
1. Analyze energy usage and uncover savings opportunities.
2. Meet and exceed energy efficiency and sustainability standards and certifications.
3. Measure return on investment of energy capital projects.
4. Decrease frequency and duration of unplanned outages.
5. Improve workplace safety by minimizing exposure to electrical hazards.
6. Provide accurate and automated documentation for regulatory compliance.

7. Improve effectiveness of equipment maintenance activities.
8. Manage multiple power generation sources effectively.
9. Increase return on electrical distribution assets.

C. Data and analytics for EPMS operations, including but not limited to, centralized display, analysis, logging, alarming, and event recording to be accessible from computer workstation with supported operating system and interface software.

D. Software Licenses:
1. License software programs provided with EPMS to Owner for use on specified system.
2. Do not restrict Owner from using software on system provided or its replacement.
3. Grant Owner right to make copies of software for use on system provided.
4. Subject to review and approval by Owner and Engineer.

E. Computer Hardware:
1. Provided by Owner, meeting EPMS supplier's minimum requirements, and supplied to EPMS supplier for configuration.
2. Use current-generation, PC-based architectures with Microsoft operating systems.
3. Provide 50 percent additional capacity for system expansion.
4. Type, Quantity, and Location: As indicated on drawings.

F. Connected Equipment and Devices:
1. Provide EPMS network-connected devices as required to support specified EPMS functionality.
2. For equipment containing connected devices, provide internal wired communications network to provide single point of connection to EPMS network.
3. Meters:
   a. Applications:
      1) Utility Revenue: Utility revenue power quality meter; for grid revenue, substation automation, network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting.
      2) Transfer Switches: Power quality meter; for automated generator test documentation.
      3) Generators: Advanced power quality meter; for automated generator test documentation.
      4) Low-Voltage Mains: Power quality meter; for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting.
      5) Low-Voltage Feeders: Power meter; for network management, energy cost allocation, asset management, operational efficiency, and compliance reporting.
      6) Low-Voltage Sub-Metering for Individual Circuits: Power meter; for network management, energy cost allocation, and operational efficiency.
      7) Low-Voltage Sub-Metering for Multiple Circuits: Multi-circuit meter; for network management, energy cost allocation, and compliance reporting.
   b. Power Quality Meters: See Section 262713.16.
   c. Advanced Power Quality Meters: See Section 262713.16.

G. Communications and Interfaces:
1. EPMS Network: Provide EPMS network using Ethernet, except where specifically indicated otherwise, for communication between EPMS system and connected equipment/devices, including but not limited to the following:
   a. Ethernet network as indicated. Provide dedicated VPN for EPMS network where physical media is shared with other networks.
   b. Serial communication connections as indicated to gateway devices for Ethernet EPMS network interface.
   c. Connection to direct digital control (DDC) system for HVAC network.

d. Connection to intelligent building management system (iBMS) network.
e. Connection to process control and instrumentation system or SCADA system network.

2. Integration with Intelligent Building Management System (iBMS):
   a. Provide iBMS access to, via web service, Modbus, BACnet or other supported open standard communication protocols, metered energy data for utilities, including water, air, gas, electricity, and steam (WAGES), from the following sub-systems:
      1) Electrical circuit breakers, power/energy meters, and power quality meters monitored by EPMS.
   b. Provide categorization for integration of metered energy data with iBMS, including but not limited to, the following load types monitored by EPMS:
      1) Lighting loads.
      2) HVAC loads.
      3) Plug loads.
      4) IT equipment loads.
      5) Special purpose loads, such as manufacturing equipment and medical equipment.
      6) Ancillary electrical loads.
   c. Provide categorization for integration of metered energy data with iBMS by associated logical entity, such as building, facility, floor, and zone, using appropriate data tags.
   d. Provide iBMS access to the following EPMS applications:
      1) Energy usage and benchmarking.
      2) Energy cost allocation.
      3) Utility bill verification.
      4) Power quality monitoring.
      5) Power events recording and analysis.
3. Cybersecurity: Comply with best practices and provide technical features to reduce risk to people, assets, and processes, including:
   a. Secure network architecture.
   b. User privilege/authentication policy.
   c. 2-factor authentication.
   d. Comply with IEC 62443 standards series, including but not limited to IEC TS 62443-1-1, IEC 62443-2-1, IEC TR 62443-2-3, IEC 62443-2-4, IEC TR 62443-3-1, IEC 62443-3-3, IEC 62443-4-1, and IEC 62443-4-2.
   e. Comply with Owner's cybersecurity program/practices.
4. Equipment Interfaces:
   a. Equipment Connected to EPMS: Provide interface compatible with EPMS network/software and required appurtenances, including gateways, transceivers, and converters, integral to equipment.
   b. Unless otherwise indicated, use Modbus TCP/IP Ethernet protocol. Use Modbus serial only where specifically indicated.

2.3 ELECTRICAL DISTRIBUTION MONITORING AND ALARMING

A. Provide screens displaying real-time data from electrical infrastructure, such as incoming utility feeds, and low-voltage distribution.

B. Display relevant real-time data from energy meters and other facility metadata, such as WAGES, industrial process data, weather, and occupancy, from connected, compatible devices, equipment, and systems.

C. Organize and display real-time data of EPMS software to provide logical views for system health and support EPMS applications.

D. Provide set of screens for electrical single-line diagram of facility, including:
   1. Links to navigate between various levels of single-line diagram.
   2. Electrical parameters for equipment components on single-line diagram, such as MV switchgear, MV transformers, generators, unit substations, LV switchboards, UPS, and isolated panel system.

3. Link to power equipment details screens.

E. Equipment Details:
1. Provide screens to display details pertaining to each piece of equipment, including equipment picture (if available), local single-line diagram (if applicable), information for each electrical section (e.g., breaker and disconnect switch), and alarm points.
2. Measured peak demand and loading of equipment (e.g., breakers, UPSs, transformers, and generators).
3. Navigation link to default diagrams of each applicable meter/protection device.

F. Floor Plans:
1. Provide set of screens displaying floor plans overlaid with relevant real-time data.
2. Digital image files provided to EPMS supplier by Owner or Engineer.
3. Provide navigation links to summary screens and equipment details screens.

G. Provide summary status screen for alarm indication for major power equipment components of electrical distribution system.

H. Alarms:
1. Organize abnormal electrical conditions, events, and group-related incidents using alarm management practices for situational awareness and actionable intelligence.
2. Notify appropriate staff members of alarms through email or SMS text messages.

2.4 POWER QUALITY (PQ) MONITORING AND COMPLIANCE

A. Monitor electrical disturbances, such as harmonics, unbalance, flicker, and over/under voltage conditions, to assist in reporting, analysis of conditions, and diagnoses of events.

B. Provide screens and reports specific to PQ, including:
1. Device Level PQ Summary Screen: Data collected by compliant PQ-capable metering device summarized to display:
a. Voltage Disturbances: Date/time of last disturbance, count of transient events, and count of sag/swell events.
b. Harmonic Measurements: Include navigation link to harmonics log for device.
c. Real-Time Harmonic Distortion Measurements: Total harmonic distortion (THD) content and maximum THD.
d. Flicker measurements.
e. Logged Events: Include navigation link to event log for device.
f. Waveform Logs: Include navigation link for waveforms captured during transients and sag/swell events.
g. Detailed waveform analysis tools.
2. System Level PQ Summary Screen: Provide PQ report displaying PQ events collected for one or more metered points within given time period.
a. Provide summary table of events within given time period and navigation link to event details (power quality details report).
b. Provide plot of Information Technology Industry Council (ITIC) curve that displays worst disturbance from each event listed in summary table, with the following for each event:
1) Event identifier.
2) Source.
3) Event timestamp.
4) Phase identifier for worst disturbance (e.g., "V1").
5) Voltage magnitude for worst disturbance in percentage of nominal (e.g., "68.8 percent").
6) Voltage magnitude maximum and minimum on phases V1, V2, and V3 for worst disturbance in percentage of nominal.
7) Duration for worst disturbance in seconds (e.g., "0.084 seconds").
8) Disturbance type for worst disturbance (e.g., "sag").

9) ITIC tolerance curve violations (e.g., "outside tolerance").
10) Link to details report.
11) Link to waveform report for worst disturbance.

c. Provide link in each summary table entry to additional details for event, including:
1) Disturbance event timestamp.
2) Phase identifier.
3) Voltage magnitude in percentage of nominal (e.g., "68.8 percent").
4) Voltage magnitude maximum and minimum on phase V1, V2, and V3 in percentage of nominal.
5) Duration in seconds.
6) Disturbance type.
7) ITIC tolerance curve violations (e.g., "outside tolerance").
8) Link to waveform report.

d. Provide navigation link in each summary table entry for waveforms of events, if available. Display waveforms for voltage and current readings of measuring point.

3. Disturbance Direction Detection:
a. For PQ-compliant devices, indicate direction of disturbance within electrical distribution system in event logs, with associated confidence/certainty rating, such as 'Upstream: Confidence Rating - High", or "Downstream: Confidence Rating – Medium".
b. Provide navigation link to detailed information for given measuring point/period.

C. PQ Analytics:
1. PQ Analytics Key Performance Indicators (KPIs):
a. PQ Downtime Impact: Display current count and trend over time for grid and facility PQ events and electrical system downtime in hours with associated cost.
b. Power Factor Impact: Display current value and trend over time for average power factor and estimated penalties/surcharges incurred.
c. PQ Index: Display overall health indicator and trend over time representing baseline for overall PQ of facility, based on analysis of PQ events and limits/thresholds defined by established PQ standards. Calculate index over various time periods and assign value on scale of "A" to "F", with "A" representing optimal and "F" representing poor.
d. PQ Event Categorization: Display event type, likely origin, and potential impact to operations in accordance with thresholds recommended by recognized PQ standards. Support flexible time periods and trending over time periods.
2. PQ Disturbance Indicator Analytics:
a. Calculate and display summary screen with high-level health indicators (red, yellow, green) for each type of PQ event/disturbance.
b. Evaluated PQ Events/Disturbances:
1) PQ Events: Voltage sags/dips, voltage swells, voltage transients, voltage interruptions, and over/under voltages.
2) PQ Disturbances: Harmonic distortion, voltage/current unbalance, frequency variation, and flicker.
c. Provide aggregate count or maximum/average values, depending on event/disturbance type.
d. For each PQ event/disturbance type, provide access to detailed information as applicable to event type, including source of event (device), timestamp, potential impact, duration, and magnitude.

2.5 POWER EVENTS RECORDING AND ANALYSIS

A. Provide event aggregation and analysis tools to gather timestamped events from compatible connected devices to provide consolidated system event view, showing date/time ordered list of events, event priority, and reporting device name.

B. Automatically acquire onboard event data and associated waveforms from power quality monitoring devices without additional software configuration or data upload scheduling.

C. Retrieve onboard, high-resolution timestamps of one-millisecond accuracy without degradation or modification, including devices supporting clock synchronization via GPS, IRIG-B, NTP, or precision time protocol (PTP).

D. High Accuracy and Resolution Event Recording: System-wide events associated with critical status points timestamped to accuracy of one millisecond.
   1. Critical status points include but are not limited to:
      a. Utility Distribution Switchgear: Multifunction electronic relays, power quality meters, and breaker open/closed/tripped position.
      b. Generator Paralleling Switchgear: Multifunction electronic relays, power quality meters, and breaker open/closed/tripped position.
      c. Substations and Low Voltage Switchgear/Switchboards: Power quality meters and breaker open/closed/tripped position.
      d. UPS, Distribution Panels, and PDUs: Power quality meters and breaker open/closed/tripped position.
   2. Mechanism of Time Synchronization: External GPS time signal or PTP over Ethernet within 100 microseconds.
   3. Sequence of Events Recording (SER) Hardware:
      a. Capable of providing synchronized timestamp signals and recording events with accuracy of one millisecond.
      b. Compatible with and natively supported by EPMS software.
      c. Include necessary components to record system events for critical status points, including but not limited to:
         1) PTP master clock.
         2) GPS antenna, cable, and lightning arrestor; provided by EPMS vendor.
         3) Clock signal distribution hardware and cabling for legacy protocols.
         4) Event recorders.
         5) Power quality meters.
         6) Multifunction electronic relays.
         7) Data network components.
         8) Enclosures.
         9) Computer equipment.
   4. Implement time stamping and event recording at local, field-device level where event occurs (e.g., event recorders, meter I/O, or relays), not at EPMS computer server. Use of software to scan, poll, and timestamp events through PLC or on server, which introduces scan time and network communication delays, is not acceptable.
   5. Dedicated Sequence of Events Recorder (SER) Hardware: Include the following for one-millisecond event recording of discrete inputs (e.g., breaker open/close/trip status):
      a. Onboard clocks time-synchronized to one-millisecond accuracy.
      b. Precision time synchronization input compatible with standard formats, including PTP, IRIG B, and DCF77.
      c. 32 high-speed digital inputs, each with configurable filter, debounce, and chatter functions.
      d. Onboard Data Logs for Storing Events: Event log capacity to store 8,000 events accessible from multiple masters. Record descriptive information for root-cause analysis, including time/date stamp, input number, event type, input status, time quality, and unique sequence number.
      e. Discrete output capable of triggering waveform capture in power quality meter, wired to designated power quality meters and prewired within connected equipment by manufacturer.
      f. Modbus RTU or Modbus/TCP interface.
      g. GPS time synchronization input compatible with IRIG B.
      h. Ethernet network interface supporting Modbus TCP/IP and embedded web server for setup and monitoring.

i. Capability to customize embedded web pages.
j. Nonvolatile memory to store setup and event data.
k. Integral SD flash memory card to store user setup values and other user files.
l. Capability to export event data in .CSV format directly from device without need for additional software.
m. Capability to serve as time distribution hub for other devices, accepting PTP precision time sync input over Ethernet and outputting required legacy protocol, such as IRIG B, DCF77, and ASCII/RS-485.

6. Multifunction Electronic Relays with Time Synchronization Capability: Provide accessible ANSI function codes of events with one-millisecond timestamp for software integration, using Modbus RTU or Modbus/TCP interface.
7. Power Quality Meters with Time Synchronization and Waveform Capability: Match one-millisecond timestamps of waveform with events that initiated waveform capture.

2.6 CAPACITY MANAGEMENT

A. Provide service and circuit load management with capacity planning compliant with NFPA 70. Provide sufficient information for operations and management decision making for site expansion and modification planning using dashboards, trending, and reporting.

B. Configured Project-Specific Requirements:
1. Monitor/aggregate measurements for source capacity to indicate degree of source loading.
2. For each circuit measured, monitor maximum load and compare to equipment capacity to indicate degree of equipment loading.
3. Identify when user-configurable threshold (e.g., 80 percent) is exceeded.
4. Provide historical trending and reporting for loading on power sources and power distribution equipment, such as automatic transfer switches, medium- and low-voltage switchgear, transformers, power distribution panels, and uninterruptible power supplies.
5. Display peak load provided by transfer switch or other equipment over given time period and compare to equipment capacity.
6. Provide summary of transfer switches or equipment in groups or daily information for each piece of equipment in group.

2.7 BACKUP POWER TESTING

A. Provide emergency power supply system (EPSS) test automation mechanism to document backup generator system testing for written record of generator system inspection, performance, testing, and repairs in accordance with applicable codes and standards, including but not limited to:
1. NFPA 110.

B. Configured Project-Specific Requirements:
1. Generator test and generator activity reports, scheduled at user-defined intervals.

C. Provide screens to display information relating to generator system testing, including:
1. General Information: Generator name, nameplate ratings, and description.
2. Testing Evaluation Data: Test load and duration.
3. Generator Status: Starting, running, and stopped.
4. Engine Data: Oil pressure, coolant temperature, and other available user-defined measurements.
5. Exhaust Gas Data: Left/right exhaust gas temperature.
6. Electrical Data: Voltage, current, active power, reactive power, apparent power, power factor, load percentage, and frequency.

D. Generator /EPSS Test Report:
1. Devices Summary Section: ATS/generator descriptions; indicate if device was excluded from report.

2. ATS Summary Section: Lead ATS, required transfer time in seconds, transfer time in seconds. Detail with priority level and transfer time for each ATS tested.
3. Generator Summary Section: Test pass/fail result and test evaluation method used.
4. Generator Load Summary Section:
   a. Load Graph:
      1) Load Evaluation Method: Compare recorded test data to required load threshold.
      2) Exhaust Gas Temperature Evaluation Method: Compare recorded test data to minimum required exhaust gas temperature.
      3) Load Bank Testing Method: Compare applicable acceptable power load thresholds with respective test data.
   b. Minimum, Maximum, and Average Table:
      1) Load Evaluation Method: Corresponding values for active power, apparent power, current per phase, and L-N/L-L voltages.
      2) Load Bank Testing Method: Corresponding values for applicable stages.
5. Generator Exhaust Temperature Summary Section:
   a. Display beginning and end timestamp for longest continuous temperature (LCT) at or above manufacturer-recommended minimum exhaust gas temperature.
   b. Display manufacturer-recommended minimum exhaust gas temperature, required run duration in minutes, and pass/fail status based on LCT.
   c. Exhaust Temperature Graph: Display required manufacturer-recommended minimum exhaust gas temperature and actual recorded exhaust gas temperature data.
   d. Exhaust Temperature Table: Display minimum, average, and maximum exhaust temperature readings for LCT at or above minimum acceptable exhaust temperature.
   e. Report Behavior: If test solution has not been configured to collect exhaust temperature data, do not include generator exhaust temperature summary section or show warning message.

E. Generator/EPSS Test Configuration:
1. Device Grouping:
   a. Provide mechanism to group generators and ATS functionally or logically for subsequent report generation.
2. Evaluation Methods Supported:
   a. Load.
   b. Exhaust gas temperature.
   c. Load bank.
   d. Load or exhaust gas temperature.
   e. Load and exhaust gas temperature.
3. Pass/Fail Criteria Settings: Based on exhaust gas temperature and/or electrical load, or load bank criteria.
4. User-Configurable Parameters:
   a. Exhaust Gas Mode: Minimum manufacturer-recommended exhaust gas temperature in degrees C or degrees F.
   b. Load Test Mode: Minimum required load as percentage of generator nameplate rating.
   c. Load Bank Mode: Load percentage and run duration for each applicable stage.
5. For each generator, support user assignment of monitoring device/transducer measurement and active value (logical 0 or 1) to logical device parameters, including but not limited to, engine start, engine running, engine stopped, oil pressure, battery voltage, and tank level.
   a. ATS Device Configuration:
      1) For each ATS, support user configuration of individual priority level, permissible transfer time, and text description.

2) Support mapping of logical ATSs to device/transducer-based parameters.
3) Support assignment of monitoring device measurement and logical 0/1 active value to test, emergency, and normal parameters.
4) Support capturing and mapping of "utility power available" status.

b. Generator/EPSS Test Report User Configuration:
1) Add EPSS report group to include in test report.
2) Exclude subset of devices from report group.
3) Choose 'reason for running report" to differentiate reporting on test versus real power outage.
4) Change report layout to selectively enable/disable displaying parameters, such as exhaust gas temperature graph and minimum/maximum/average voltage, current, power, frequency, and exhaust gas temperature data.

c. Support data quality checks with warnings for issues (e.g., missing data).

F. Generator Capacity Planning Report: Customizable to accommodate site redundancy.
1. Report available capacity before designed redundancy is compromised, or show if system is oversubscribed, and by how much.
2. Graphically display level of redundancy of generator equipment during user-selected time period.
3. Display redundancy design limit.
4. Display peak system load.
5. Display calculated difference between redundancy design limit and peak system load.

G. Generator Fuel Monitoring: When integrated with generator testing system, provide capability to display facility fuel data, including:
1. Volume of fuel left in tank.
2. Available run time, based on fuel levels and tank temperature.
3. Alarms for leaks, low fuel levels, and water presence.

H. Generator Activity Report:
1. List each instance generator was run, categorize reason (e.g., test or emergency), and provide cumulative total of emergency/nonemergency run time.
2. Compare number of nonemergency hours with allowable threshold (e.g., 100 hours) for reporting period.

I. Generator Load Summary: Show electrical data captured during run of generator, including load graph with kW and kVA and summary table with minimum/maximum/average, with option to include table with electrical details.

2.8 ASSET PERFORMANCE

A. Circuit Breaker Aging: Provide low-voltage (LV) circuit breaker aging monitoring to provide estimate of electrical and environmental aging data of supported breakers for preventive maintenance planning for LV switchgear.
1. Provide circuit breaker aging report, including:
a. Electrical aging, in percent.
b. Environmental aging, in percent.
c. Classification of breakers by group and aging status.
2. Aging Algorithm: Estimate aging percentages for supported devices using electrical and environmental parameters, including:
a. Overload tripping.
b. Short-circuit tripping.
c. Operation.
d. Commissioning date.
e. Ambient temperature.
f. Vibration.
g. Humidity.

B. Generator Battery Health: Monitor generator battery health by capturing battery voltage signatures during generator starts. Compare signatures to provide predictive maintenance insight into when batteries need replacement or related equipment needs servicing.

2.9 LOW-VOLTAGE (LV) CIRCUIT BREAKER SETTINGS MONITORING

A. Capabilities:
1. View protection settings for LV circuit breakers in real-time.
2. Generate report, for audit purposes, summarizing protection settings of LV circuit breakers.
3. Trigger alarm upon changes to breaker settings as compared to previously recorded baseline.

B. Provide breaker settings report, including:
1. Breaker name, protection settings/modes, and maintenance status.
2. Current recorded value with timestamp.
3. Previously recorded baseline value with timestamp.
4. Highlight changes between baseline and changed values.

2.10 EPMS ADVISORY SERVICES

A. Provide separate contract to Owner, as proposal in addition to base bid, for EPMS advisory services for two years from date of Substantial Completion. Include proposal for yearly renewals.

B. Provide ongoing technical support services to advise on, optimize, and tune performance of EPMS.
1. Use EPMS via internet connection for read-only data access for functionality; do not modify data; devices not capable of being controlled.
2. Analyze data on electrical power distribution equipment, identify problems through expert analysis, and provide recommended actions for system improvement.
3. Provide expert analysis through review of data and reports by qualified electrical power distribution and power quality professionals.

C. Services:
1. Periodic monitoring of EPMS server(s) and software to alert for system problems, including but not limited to, areas of communications infrastructure and software diagnostics.
2. Specialized EPMS diagnostic and analytics tools with capabilities for detection, diagnosis, and mitigation recommendations, including:
a. Communications issues (e.g., loss of communications and intermittent problems).
b. Electrical and load issues (e.g., CT shorting blocks left closed, voltage disconnects left open, miswired or disconnected phases, and incorrectly sized CTs).
c. Sensor issues (e.g., CT polarity errors, malfunctioning pulse counters, and incorrect phase wiring).
d. Configuration issues (e.g., incorrectly configured logging triggers, measurement unit mismatches, and incorrect PT/CT ratios).
e. Measurement issues (e.g., energy balance mismatches).
f. Overall system health issues (e.g., data corruption, missing data, operating system errors, excessive CPU usage, disk usage, and low-memory errors).
g. Electrical systemic power quality issues (e.g., over/undervoltage, voltage imbalances, excessive lagging power factor, and excessive harmonic distortion).
h. Alarm diagnostics to detect nuisance alarm behaviors (e.g., chattering, intermittent, stale, and flooding).
i. Provide recommendations engine for:
1) Harmonic mitigation equipment, to correct detected excessive harmonic conditions.

2) Mitigation equipment, to correct detected excessive power factor conditions.

3. Software verification, including provision of service packs and license upgrades for installed EPMS software. Software upgrades installed and verified at additional cost in accordance with advisory service rates and fees.
4. Minimum of one yearly visit for on-site maintenance, including system repairs, database maintenance, firmware upgrades, and software installations. Training on system operation provided during on-site maintenance visit by application engineer.
5. Basic support via telephone and email during regular business hours to provide technical guidance, incident diagnosis, basic troubleshooting, and instructions to operate installed software and hardware.
6. Emergency after-hours support with guaranteed response within four hours.
7. Reserved support engineer as single point of contact for customer support.
8. Direct access to advanced-level support, with priority case escalation to expert-level support. Provide quarterly proactive system maintenance.
9. Periodic reports with system optimization recommendations and actionable work orders.
10. System benchmark of site with system score indicating percentage of load potentially impacted or affected. Include Owner and/or Engineer in setup of metering hierarchy in EPMS advisory services to ensure relevancy of benchmark.
11. Periodic executive/detailed report to promote power reliability; prioritize identified electrical network issues based on severity.
12. Quarterly recommendations for system optimization to improve data quality and system performance.
13. On-demand, self-paced training with energy management, metering infrastructure, and power quality content modules.

D. Products:
1. Schneider Electric; EcoStruxure Power Advisor.

2.11 ENERGY USAGE AND BENCHMARKING

A. Provide energy analysis and benchmarking features to isolate factors contributing to energy usage, analyze energy usage patterns, and implement energy conservation measures.

B. Capabilities:
1. Categorize energy usage by load types to identify where to focus energy conservation initiatives.
2. Compare energy usage across various entities, such as buildings, departments, plants, and processes.
3. Analyze factors contributing to energy usage/patterns and isolate energy waste.
4. Compare energy usage by normalizing consumption with respect to area, production volume, or other energy drivers.

C. Configured Project-Specific Requirements:
1. Energy analysis reports, scheduled at user-defined intervals.
2. Dashboard screens displaying relevant energy analysis parameters, model, and other performance parameters.

D. Provide report templates to support benchmarking initiatives for improved energy efficiency, including:
1. Energy Comparison Report: Display and compare normalized energy consumption.
2. Energy Dashboards: Compare normalized energy consumption between sites or other organizational entities, such as buildings, plants, and processes.
3. Calendar Trend: Display energy data in interactive monthly/weekly calendar views monthly/weekly, with overlaid target lines.
4. Duration Curve: Display data organized by order of magnitude, rather than chronological, with overlaid target lines.

E. Support importing and logging parameters for normalization calculations, including:
   1. Area (square feet/square meters).
   2. Outdoor temperature.
   3. Humidity.
   4. Building occupancy.
   5. Manufacturing productivity (number of devices produced).

F. Operating States: Support energy usage analysis for operating states to facilitate energy efficiency initiatives for operational systems, such as HVAC and industrial processes, including:
   1. For each operating state, such as off, normal, and high, calculate and display equipment energy and power consumption, including percentages for water, air, gas, electricity, and steam (WAGES).
   2. Calculate and display operational equipment statistics, including hours of operation in each state/mode, percentage hours in each state/mode, activations for each state/mode, and average duration operating in each state/mode.
   3. Provide report templates that support:
      a. Configurable reporting/aggregation time periods and state annotation.
      b. Flexible output formats, such as pie, stacked column, and data table.

2.12 CONTINUOUS THERMAL MONITORING

A. Provide real-time thermal monitoring functionality through data and analytics to detect abnormal thermal conditions within electrical distribution equipment. Periodic infrared thermal scanning is not acceptable.

B. Capabilities:
   1. Screens displaying real-time temperature and humidity conditions for compatible medium- and low-voltage switchgear, and low-voltage busway systems, including:
      a. Maximum per-phase and discrepancy temperatures for measured connection points.
      b. Ambient temperature and relative humidity within equipment.
   2. Store, analyze, and report historical data for thermal parameters.
   3. Plot real-time temperature readings through trend plots that can support display of target threshold lines and aggregate values (minimum, maximum, and average).
   4. Display thermal alarms and events with pre-alarm and threshold values.
   5. Display sensor communication status alarms.
   6. Configure email/text notifications upon triggering of thermal alarms.

2.13 ARC-FLASH PROTECTION

A. Provide visualization, event logging, and root-cause analysis of arc-flash events.

B. Capabilities:
   1. Graphically indicate occurrence of arc-flash event on real-time display.
   2. Aggregate arc-flash alarms within EPMS integrated electrical distribution monitoring/alarm management system and root-cause analysis tools.
   3. Configure email/text notifications upon triggering of arc-flash alarms.

C. Support native integration of compatible protective relays with integral arc-flash sensor inputs.

2.14 EPMS SOFTWARE

A. Basis of Design: Schneider Electric; Square D EcoStruxure Power Monitoring Expert

B. Provide dedicated, edge control, software platform designed as operational interface for EPMS to manage safe, reliable, and efficient power within buildings/facilities.

C. Provide specialized data acquisition, visualization, analysis, and reporting tools designed for power management applications.

D. Support minimum of 100 devices designed for power distribution and power quality (PQ) monitoring, including programmable power analyzers, power meters, branch/multi-circuit meters, smart panels with communicating circuit breakers, protective relays, uninterruptible power supplies, active harmonic filters, capacitor bank controllers, and electrical distribution thermal sensors.

E. Provide native device support, without requiring additional installation or configuration, including:
   1. Registers premapped to standard measurement names.
   2. Set of factory device graphical screens.
   3. Factory-tested support.

F. Cybersecurity: Comply with IEC 62443-4-1 and IIEC 62443-4-2 at component level.

G. Certify for use in energy data management system in accordance with the following:
   1. ISO 50001:
      a. Energy review.
      b. Energy baseline.
      c. Energy performance indicators.
      d. Monitoring, measurement, and analysis.
      e. Input to management review.
   2. ISO 50002:
      a. Data collection.
      b. Measurement plan.
      c. Analysis.
      d. Energy audit reporting.
   3. ISO 50006:
      a. Obtain relevant energy performance information from energy review.
      b. Identify energy performance indicators.

H. Natively support continuous electrical thermal monitoring system with capability to detect abnormal bus bar or cable temperatures due to loose/faulty connections in order to prevent equipment damage and fire.

I. Natively support active arc flash protection system with capability to detect/display arc flash alarm.

J. Real Time Monitoring:
   1. Support creation of diagrams representing power monitoring system, including electrical one-line diagrams, facility maps, plan views, floor layouts, equipment representations, and mimic displays. Provide graphic library with standard electrical one-line symbols.
   2. Support graphical trending of real-time measurements supported by metered connected electrical equipment.
   3. Support creation of interactive, side-by-side visualizations of real-time measurements, including:
      a. Display tabular and trend line views to compare readings from multiple devices.
      b. Create, modify, view, and share table views directly, without additional software.
      c. Support both physical and virtual devices defined in system.
      d. Support exporting of real-time data into Excel formats, without additional software.
   4. Provide automatic network diagram creation feature to support automatic creation of linked hierarchical graphical diagrams for connected devices.
   5. Support advanced power quality meters with integral high-speed power analysis and disturbance direction detection (DDD); include set of real-time graphical objects for use in electrical diagrams to indicate:
      a. Type of power quality disturbance (sag, swell, transient).
      b. Direction of PQ disturbance relative to reporting DDD device (upstream, downstream).

6. Provide real-time indication of aggregated demand measured by one or more devices in predefined zone, including:
    a. Zone demand expressed using kW or normalized kW/area.
    b. Visual indication of present zone demand comparison with four configurable limits/ targets, using color scale.
    c. Different values for configurable limits during on-peak and off-peak periods.

K. Alarm/Event Analysis and Notification:
1. Support acquisition of specialized high-speed power disturbance data from advanced PQ meters for power events analysis, including:
    a. Timestamped power events with disturbance direction detection (DDD).
    b. Timestamped high-speed (1/2-cycle sample rate) pre/post event RMS data.
    c. Pre/post event waveform captures (voltage and current, for all phases).
2. Provide alarm annunciator to display number of unacknowledged alarms with categorization into high, medium, and low priority, with navigation to alarm viewer.
3. Support analysis of cascading power events, including:
    a. Automatic, intelligent clustering of events into grouped alarms, and multiple alarms from multiple devices into incidents.
    b. Automatic categorization of alarms and incidents into predefined categories, including power quality, power availability, and diagnostics.
    c. Predefined views for events, alarms, and incidents with navigation and configurable filters based on priority, status, source, and categories.
    d. Creation of private or shared views with custom filters.
    e. Access to details on location, time, and nature of alarm or incident, with associated information including power disturbance and power quality data.
    f. Graphical indication of power disturbance direction for alarms and incidents captured by DDD-capable devices.
4. Provide graphical timeline view of alarms and events constituting incidents in electrical distribution network, including:
    a. Display alarms/events stacked by order of time for sequence of events analysis.
    b. Display start and end of alarms/events.
    c. Indicate direction of incident with associated captured waveforms.
    d. Display pre- and post-event high speed RMS data from supported PQ meters.
5. Support sending of email notifications based on changes to system, including:
    a. Communication Loss: Sent on loss of communication with selected devices.
    b. Alarm Summary: Sent regularly to indicate changes in average amount of high-, medium-, and low-priority alarms.
    c. Real-Time Analog and Digital Setpoints: Include options for time delays and custom alarm labels.
    d. Dynamic Setpoints: Designed for WAGES energy and power alarms based on historical average, standard deviation, or maximum, with options for time ranges, aggregation periods, multipliers, and comparison of time periods.
    e. Power Quality Event: Sent regularly to indicate change in average amount, duration, and magnitude of sag, swell, and transient power disturbances.
    f. Energy Usage: Sent when energy exceeds normal range for current day and time.

L. Data Analytics and Visualization:
1. Provide interactive, web-based dashboard application for water, air, gas, electric, steam (WAGES) data, historical data trends, power quality, images, and external content from URL addresses.
2. Provide capability to create, modify, view, and share dashboards, including graphics, labels, scaling, measurements, and date ranges, without additional software.

3. Support creation and configuration of kiosk slideshow displays to run independently on computer with browser in unattended mode, scrolling through designated dashboards at configurable time interval.
4. Provide library of graphical objects (gadgets):
   a. Standard: Include bar, pie, trend, real time, and web portal.
   b. Specialized Energy Usage: Include period over period comparison, pareto charts, heat map/carpet plot, and sankey diagrams.
5. Provide interactive, web-enabled interactive reports application with capability to generate, modify, save, and manage reports based on pre-engineered report templates for:
   a. Energy billing, verification, and allocation.
   b. Energy management and performance.
   c. Power quality performance and compliance.
   d. System average RMS variation frequency index (SARFI).
   e. Operation and performance for electrical equipment, such as breakers, UPSs, and generators.
6. Support automatic distribution of reports via email or shared folder on scheduled basis, based on event, or manual export including .csv, .xlsx, .pdf, .tiff, .html, and .xml formats.

M. Technical Infrastructure:
1. Support installation on physical computer or virtual machine, on Server and non-Server class Windows operating systems.
2. Support SQL Server, including Enterprise, Standard, and Express editions.
3. Only require SQL Server Database Engine Services and Basic Management Tools; do not require additional SQL components, such as Analysis Services or Reporting Services.
4. Cybersecurity:
   a. Support encrypted transmission of data between software platform server and web clients using transport layer security (TLS) version 1.2.
   b. Support secure authentication between software platform server and web clients using certification authority (CA) certificates.
   c. Support encryption and hashing of system credentials using AES256 and SHA-512, respectively.
   d. Support installation in environment complying with Federal Information Processing Standards (FIPS).
5. Support integration of Windows Active Directory across multiple domains, including:
   a. Login using Windows credentials.
   b. Enforcement of password complexity and expiration policies via Windows.
   c. Role-based access control (RBAC).
6. Automatically acquire onboard data, including events, trends, and waveforms, from natively supported device types without additional software configuration or data upload scheduling.
7. Retrieve onboard, high-resolution (1 ms) timestamps of one-millisecond accuracy without degradation or modification, including devices supporting clock synchronization via GPS, IRIG-B, NTP, or precision time protocol (PTP).
8. Support logical device definitions based on inputs/outputs or channels on devices representing downstream circuits, including:
   a. User interface for device and measurement mapping.
   b. Bulk-import capability to create large numbers of logical devices without manual single-device configuration.
9. Support real-time and historical data aggregation within defined hierarchy views (e.g., tenants/racks/circuits, PDUs/RPPs/panels, or buildings/floors/rooms), or user-defined hierarchy view, including:
   a. Web-based, end-user interface.
   b. Automatic, intelligent data aggregation across hierarchy nodes for data visualization in dashboards, trends, and reports.
   c. Creation of virtual devices to enable net metering, common area allocation, and apportionment.

d. Updating of hierarchy node names and associated time ranges to accurately represent and report facility changes (e.g., tenant move-in/out).
e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.

10. Device-Level Modbus Integration:
    a. Modbus master to read/write registers in Modbus devices for monitoring and control applications.
    b. User interface to create and manage Modbus device definitions/drivers and association of device graphic template screens.
11. OPC Data Access Server 2.01 Support:
    a. Provide default OPC server tag mappings for natively supported device types without requiring manual mapping of device registers to OPC tags.
    b. Add or change OPC mappings or add custom measurements.
12. OPC Data Access Client 2.01 Support:
    a. User interface to create and manage OPC device definitions/drivers and association of device graphic template screens.
    b. Built-in OPC Test Client.
13. Web Services Interoperability:
    a. Web services server to share real-time, historical (i.e., timestamped trend data), and alarm (i.e., timestamped event strings) data to other web services client applications.
    b. User interface for web services configuration and mapping.
    c. Ability to acknowledge alarms by authenticated and authorized clients.
14. Provide extract, transform, and load (ETL) engine to exchange data between files, databases, and systems, including:
    a. User interface to specify connection information, data formats, measurement mappings, and schedules.
    b. Support for importing data from .csv and .xml data files, AVEVA Historian databases, and third-party databases via OleDB connections.
15. Support system-wide programming extensibility, using graphical, object-oriented application engine capable of logic and arithmetic functions, database queries, XML data import, complex logic-based alarming and data logging, and email/text notifications.
16. Remain online during system administration functions, including communications, logging, and alarming; do not require operator to take system offline.
17. Support internationalization and regional settings, with factory support for simplified Chinese, traditional Chinese, English, French, German, Italian, Russian, Spanish, Polish, Czech, and Swedish languages. Support capability to change default language without additional installation or advanced software configuration.
18. Support offline software configuration management for efficient system deployments and upgrades with dedicated user interface for creating, copying, and deploying software configuration projects.

N. Products:
    1. Schneider Electric; Square D EcoStruxure Power Monitoring Expert

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.

B. Examine for conditions detrimental to completion of work.

3.2 INSTALLATION

A. Install equipment in accordance with manufacturer’s written instructions.

B. Install equipment in accordance with NECA 1.

3.3 FIELD QUALITY CONTROL

A. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
   1. Include necessary material, equipment, labor, and technical supervision.
   2. On-site commissioning to be performed by factory-trained personnel using automated commissioning tools.
   3. System to be prepared for startup by EPMS supplier's central engineering resources in conjunction with on-site factory-trained personnel.
   4. EPMS manufacturer to provide trained and certified project manager during project installation and commissioning.
   5. For control applications, such as automatic transfer, include verification of approved sequence of operation in both manual and automatic modes. Include testing of source outage and breaker exercising.
   6. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.
   7. Identify EPMS equipment with label indicating inspection/testing agency and date of service.

3.4 CLOSEOUT ACTIVITIES

A. Training:
   1. On-Site Training: Train Owner's personnel on operation and maintenance of system.
      a. Accommodate minimum of ten attendees.
      b. Provide not less than one session with four hours of hands-on training.
      c. For each student, provide compact power monitoring system demonstration unit, direct Ethernet communication, and laptop running applicable metering software.
      d. Training Reference: Provide training manuals for each student; include agenda, defined objectives for each lesson, detailed description of subject matter , and descriptive labs to complete hands-on exercises.
      e. Instructor: Factory-trained manufacturer's representative with direct experience with EPMS.
   2. Provide sufficient time and detail in each session to cover the following at minimum:
      a. Operation theory.
      b. Major equipment components.
      c. System and software function and operation.
      d. Definition and use of various system data, such as energy, demand, power factor, load profile, time of use, and KYZ.
      e. System architecture and communications methods.
      f. System optimization.
      g. Electric meter function and operation.
   3. Additional Training Sessions:
      a. Self-paced on-demand training on energy management, metering infrastructure, and power quality.
      b. At project site, hands-on training using power monitoring equipment involving hardware and software to train Owner to implement, operate, and maintain power monitoring system.
         1) Video recording services to coincide with custom client on-site training with professional postproduction services.
      c. Instructor-led, remote web-based training providing real-time interaction with trainer using virtual servers to perform labs and exercises.

3.5 PROTECTION

A. Protect installed EPMS equipment from subsequent construction operations.

3.6 MAINTENANCE

A. Provide to Owner, as alternate to base bid, separate contract for switchgear service plan for two years from date of Substantial Completion including, but not limited to, dedicated customer success management team, priority remote and on- expert support, discounted service rates, continuous monitoring and alarming, online training.

END OF SECTION 26 09 13

SECTION 26 09 13 - ELECTRICAL POWER MONITORING AND CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following for monitoring of electrical power system:
   1. PC-based workstation(s) and software.
   2. Communication network and interface modules for RS-232, RS-485, Modbus TCP/IP and IEEE 802.3 data transmission protocols.

1.2 DEFINITIONS

A. Ethernet: Local area network based on IEEE 802.3 standards.

B. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

C. HTML: Hypertext markup language.

D. I/O: Input/output.

E. KB: Short for kilobyte. When used to describe data storage, "KB" represents 1024 bytes.

F. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.

G. LAN: Local area network; sometimes plural as "LANs."

H. LCD: Liquid crystal display.

I. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less that 50 V or remote-control, signaling and power-limited circuits.

J. Modbus TCP/IP: An open protocol for exchange of process data.

K. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

L. PC: Personal computer; sometimes plural as "PCs."

M. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

N. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.

O. RS-485: A TIA standard for multipoint communications using two twisted-pairs.

P. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

Q. THD: Total harmonic distortion.

R. UPS: Uninterruptible power supply; used both in singular and plural context.

S. WAN: Wide area network.

1.3 SUBMITTALS

A. Submit product data and shop drawings in accordance with Division 01 for products specified under PART 2 - PRODUCTS.

B. Product Data: For each type of product indicated.
1. Attach copies of approved Product Data submittals for products that include power monitoring (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.

C. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.
1. Outline Drawings: Indicate arrangement of components and clearance and access requirements.
2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
5. UPS sizing calculations for workstation.

D. Software and Firmware Operational Documentation:
1. Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
2. Software operating and upgrade manuals.
3. Software Backup: On a magnetic media or compact disc, complete with Owner-selected options.
4. Device address list and the set point of each device and operator option, as set in applications software.
5. Graphic file and printout of graphic screens and related icons, with legend.

E. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or power monitoring and control revisions.

F. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

G. Qualification Data: For Installer and manufacturer.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Operating and applications software documentation.
2. Software licenses.
3. Software service agreement.
4. PC installation and operating documentation, manuals, and software for the PC and all

installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.

5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard- copy submittal.

J. Other Informational Submittals:

1. System installation and setup guides, with data forms to plan and record options and setup decisions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.

1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Addressable Relays: One for every ten installed. Furnish at least one of each type.
2. Data Line Surge Suppressors: One for every ten of each type installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric product.

2.2 FUNCTIONAL DESCRIPTION

A. Instrumentation and Recording Devices: Monitor and record load profiles and chart energy consumption patterns.
   1. Calculate and Record the Following:
      a. Load factor.
      b. Peak demand periods.
      c. Consumption correlated with facility activities.
   2. Measure and Record Metering Data for the Following:
      a. Electricity.

B. Power Quality Monitoring: Identify power system anomalies and measure, display, and record trends and alarms for all quality power parameters as described in other sections of this division including but not limited to the following:
   1. Voltage regulation and unbalance.
   2. Continuous three-phase RMS voltage.
   3. Periodic max./min./avg. samples.
   4. Harmonics.
   5. Voltage excursions.

C. Emergency Load Shedding. Preserve critical loads or avoid total shutdown due to unforeseen loss of power sources according to the following logic:
   1. Determine system topology.
   2. Evaluate remaining loads and sources.
   3. Shed loads in less than 100 ms.

D. Demand Management:
   1. Load interlocking.
   2. Load shedding.

E. System: Report equipment status and power system control.

2.3 SYSTEM REQUIREMENTS

A. Monitoring and Control System: Include multiple PC-based workstations with graphics capability and Web access, with its operating system and application software, connected to data transmission network.

B. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.
   1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section 26 43 13 "TVSS for Low-Voltage Electrical Power Circuits."
   2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.

C. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

2.4 OPERATING SYSTEM

A. Software: Configured for a server and multiple client PCs, each with capability for accessing multiple devices simultaneously. Software shall include interactive graphics client and shall be Web enabled. Workstations and portable computers shall not require any software except for an Internet browser to provide connectivity and full functionality. Include a firewall

recommended by manufacturer. 100 Base-T Ethernet, Modbus TCP/IP RS-232, and RS-485 digital communications.

B. Coordinate with IT to put on the network building.

C. Operating System Software: Based on industry standard bit Microsoft Windows workstation operating system. Software shall have the following features:
   1. Multiuser and multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
   2. Graphical user interface to show pull-down menus and a menu tree format.
   3. Capability for future additions within the indicated system size limits.

D. Peer Computer Control Software: Shall detect a failure of workstation and associated server, and shall cause other workstation and associated server to assume control of all system functions without interruption of operation. Drivers shall be provided in both central computers to support this mode of operation.

2.5 APPLICATIONS SOFTWARE

A. Basic Requirements:
   1. Fully compatible with and based on the approved operating system.
   2. Password-protected operator login and access; three levels, minimum.
   3. Password-protected setup functions.
   4. Context sensitive on-line help.
   5. Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
   6. Capability for importing custom icons into graphic views to represent alarms and I/O devices.
   7. Automatic and encrypted backups for database and history; automatically stored at central control PC and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
   8. Operator audit trail for recording and reporting all changes made to user-defined system options.

B. Workstation Server Functions:
   1. Support other client PCs on the LAN and WAN.
   2. Maintain recorded data in databases accessible from other PCs on the LAN and WAN.

C. Data Formats:
   1. User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
   2. Option to convert reports and graphics to HTML format.
   3. Interactive graphics.
   4. Option to send preprogrammed or operator designed e-mail reports.

D. Metered Data: Display metered values in real time.

E. Equipment Documentation: Database for recording of equipment ratings and characteristics; with capability for graphic display on monitors.

F. Graphics: Interactive color-graphics platform with pull-down menus and mouse-driven generation of power system graphics, in formats widely used for such drafting; to include the following:
   1. Site plan.
   2. Floor plans.

3. Equipment elevations.
4. Single-line diagrams.

G. User-Defined Monitoring and Control Events: Display and record with date and time stamps accurate to 0.1 second, and including the following:
1. Operator log on/off.
2. Attempted operator log on/off.
3. All alarms.
4. Equipment operation counters.
5. Out-of-limit, pickup, trip, and no-response events.

H. Trending Reports: Display data acquired in real-time from different meters or devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends.
1. Spreadsheet functions of sum, delta, percent, average, mean, standard deviation, and related functions applied to recorded data.
2. Charting, statistical, and display functions of standard Windows-based spreadsheet.

I. Alarms: Display and record alarm messages from discrete input and controls outputs, according to user programmable protocol.
1. Functions requiring user acknowledgment shall run in background during computer use for other applications and override other presentations when they occur.

J. Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event; include the graphic displays of the following, based on user-specified criteria:
1. Phase voltages, phase currents, and residual current.
2. Overlay of three-phase currents, and overlay each phase voltage and current.
3. Waveforms ranging in length from 2 cycles to 5 minutes.
4. Disturbance and steady-state waveforms up to 512 points per cycle.
5. Transient waveforms up to 83,333 points per cycle on 60-Hz base.
6. Calculated waveform on a minimum of four cycles of data of the following:
a. THD.
b. RMS magnitudes.
c. Peak values.
d. Crest factors.
e. Magnitude of individual harmonics.

K. Data Sharing: Allow export of recorded displays and tabular data to third-party applications software.

L. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
1. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
2. Sort and report by device name and by function.
3. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
4. Differentiate alarm signals from other indications.
5. When system is reset, report reset event with same information concerning device, location, date, and time.

2.6 COMMUNICATION COMPONENTS AND NETWORKS

A. Transient Voltage Surge Suppression and Electromagnetic-Interference Immunity: Include in solid-state equipment. Comply with IEEE C37.90.

B. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

2.7 POWER MONITORS

A. Separately mounted, permanently installed instrument for power monitoring and control.
   1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) Insert temperature range dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. RMS Real-Time Measurements:
   1. Current: Each phase, neutral, average of three phases, percent unbalance.
   2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
   3. Power: Per phase and three-phase total.
   4. Reactive Power: Per phase and three-phase total.
   5. Apparent Power: Per phase and three-phase total.
   6. Power Factor: Per phase and three-phase total.
   7. Displacement Power Factor: Per phase and three-phase total.
   8. Frequency.
   9. THD: Current and voltage.
   10. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
   11. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
   12. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

D. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:
   1. Present.
   2. Running average.
   3. Last completed interval.
   4. Peak.

E. Demand Real Power Calculations, Three-Phase Total:
   1. Present.
   2. Running average.
   3. Last completed interval.
   4. Predicted.
   5. Peak.
   6. Coincident with peak kVA demand.
   7. Coincident with kVAR demand.

F. Demand Reactive Power Calculations, Three-Phase Total:
   1. Present.
   2. Running average.
   3. Last completed interval.
   4. Predicted.
   5. Peak.
   6. Coincident with peak kVA demand.
   7. Coincident with kVAR demand.

G. Demand Apparent Power Calculations, Three-Phase Total:
   1. Present.
   2. Running average.
   3. Last completed interval.
   4. Predicted.
   5. Peak.
   6. Coincident with peak kVA demand.
   7. Coincident with kVAR demand.

H. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:
   1. Last completed interval.
   2. Coincident with kW peak.
   3. Coincident with kVAR peak.
   4. Coincident with kVA peak.

I. Power Analysis Values:
   1. THD, Voltage and Current: Per phase, three phase, and neutral.
   2. Displacement Power Factor: Per phase, three phase.
   3. Fundamental Voltage, Magnitude and Angle: Per phase.
   4. Fundamental Currents, Magnitude and Angle: Per phase.
   5. Fundamental Real Power: Per phase, three phase.
   6. Fundamental Reactive Power: Per phase.
   7. Harmonic Power: Per phase, three phase.
   8. Phase rotation.
   9. Unbalance: Current and voltage.
   10. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 63rd harmonic.

J. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:
   1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
   2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
      a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
      b. Fixed block that calculates demand at end of the interval.
      c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
   3. Demand Calculation Initiated by a Synchronization Signal:
      a. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
      b. Demand can be synchronized with clock in the power meter.

K. Sampling:
   1. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
   2. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.

L. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:
   1. Line-to-line voltage.
   2. Line-to-neutral voltage.

3. Current per phase.
4. Line-to-line voltage unbalance.
5. Line-to-neutral voltage unbalance.
6. Power factor.
7. Displacement power factor.
8. Total power.
9. Total reactive power.
10. Total apparent power.
11. THD voltage L-L.
12. THD voltage L-N.
13. THD current.
14. Frequency.

M. Harmonic Calculation: Display and record the following:
1. Harmonic magnitudes and angles for each phase voltage and current through 63rd Insert number harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of RMS values, as selected by user.

N. Current and Voltage Ratings:
1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall be not less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Designed for use with voltage inputs from standard instrument potential transformers with a 120-V secondary.

O. Accuracy:
1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters.
2. Accuracy from Light to Full Rating:
   a. Power: Accurate to 0.25 percent of reading, plus 0.025 percent of full scale.
   b. Voltage and Current: Accurate to 0.075 percent of reading, plus 0.025 percent of full scale.
   c. Power Factor: Plus or minus 0.002, from 0.5 leading to 0.5 lagging.
   d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.

P. Waveform Capture:
1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.
2. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

Q. Input: One digital input signal(s).
1. Normal mode for on/off signal.
2. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
3. Conditional energy signal to control conditional energy accumulation.

R. Outputs:
1. Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.
2. Closed in either a momentary or latched mode as defined by user.

3. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
4. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V RMS isolation.
5. One relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
6. Output Relay Control:
    a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
    b. Normally open and normally closed contacts, field configured to operate as follows:
        1) Normal contact closure where contacts change state for as long as signal exists.
        2) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
        3) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
        4) End of power demand interval when relay operates as synchronization pulse for other devices.
        5) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
        6) Output controlled by multiple alarms using Boolean-type logic.

S. Onboard Data Logging:
1. Store logged data, alarms, events, and waveforms in 800 KB of onboard nonvolatile memory.
2. Stored Data:
    a. Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 to 52 days of 15-minute interval data, depending on number of quantities selected.
    b. Custom Data Logs: Three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:
        1) Schedule interval.
        2) Event definition.
        3) Configured as "fill-and-hold" or "circular, first-in first-out."
    c. Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
    d. Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."
3. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

T. Alarms.
1. User Options:
    a. Define pickup, dropout, and delay.
    b. Assign one of four severity levels to make it easier for user to respond to the most important events first.
    c. Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.
2. Alarm Events:
    a. Over/undercurrent.
    b. Over/undervoltage.
    c. Current imbalance.
    d. Phase loss, current.

e. Phase loss, voltage.
f. Voltage imbalance.
g. Over kW demand.
h. Phase reversal.
i. Digital input off/on.
j. End of incremental energy interval.
k. End of demand interval.
U. Control Power: 90- to 457-V ac or 100- to 300-V dc.
V. Communications:

1. Power monitor shall be permanently connected to communicate via Modbus TCP via a 100 Base-T Ethernet.
2. Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.

W. Display Monitor:

1. Backlighted LCD to display metered data with touch-screen selecting device.
2. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
3. Display four values on one screen at same time.
   a. Current, per phase RMS, three-phase average and neutral.
   b. Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
   c. Real power, per phase and three-phase total.
   d. Reactive power, per phase and three-phase total.
   e. Apparent power, per phase and three-phase total.
   f. Power factor, per phase and three-phase total.
   g. Frequency.
   h. Demand current, per phase and three-phase average.
   i. Demand real power, three-phase total.
   j. Demand apparent power, three-phase total.
   k. Accumulated energy (MWh and MVARh).
   l. THD, current and voltage, per phase.
4. Reset: Allow reset of the following parameters at the display:
   a. Peak demand current.
   b. Peak demand power (kW) and peak demand apparent power (kVA).
   c. Energy (MWh) and reactive energy (MVARh).

2.8 STANDALONE, WEB-ENABLED MONITORING AND CONTROL INSTRUMENT

A. Separately mounted, permanently installed instrument for power monitoring and control.
   1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability.
   1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. Power-Distribution Equipment Monitor: Web enabled, with integral network port and embedded Web server with factory-configured firmware and HTML-formatted Web pages for viewing of power monitoring and equipment status information from connected devices equipped with digital communication ports.

D. LAN Connectivity: Multipoint, RS-485 Modbus serial communication network,

interconnecting all breaker trip units, protective relays, drives, and metering devices equipped with communications. Serial communication network connected to Ethernet server that functions as a gateway and server, providing data access via 100 Base-T LAN.

E. Communication Devices within the Equipment: Addressed at factory and tested to verify reliable communication with network server.

F. Server Configuration:
   1. Initial network parameters set using a standard Web browser. Connect via a local operator interface, or an RJ-45 port accessible from front of equipment.
   2. Network server shall be factory programmed with embedded HTML-formatted Web pages that are user configurable and that provide detailed communication diagnostic information for serial and Ethernet ports as status of RS-485 network; with internal memory management information pages for viewing using a standard Web browser.
   3. Login: Password protected; password administration accessible from the LAN using a standard Web browser.
   4. Operating Software: Suitable for local access; firewall protected.

G. Data Access:
   1. Network server shall include embedded HTML pages providing real-time information from devices connected to RS-485 network ports via a standard Web browser.

H. Equipment Monitoring Options: Login shall be followed by a main menu for selecting summary Web pages that follow.

I. Summary Web pages shall be factory configured to display the following information for each communicating device within the power equipment lineup:
   1. User-Configurable Custom Home Page: Provide for the lineup, showing status-at-a-glance of key operating values.
   2. Circuit Summary Page: Circuit name, three-phase average RMS current, power (kW), power factor, and breaker status.
   3. Load Current Summary Page: Circuit name, Phase A, B, and C RMS current values.
   4. Demand Current Summary Page: Circuit name, Phase A, B, and C average demand current values.
   5. Power Summary Page: Circuit name, present demand power (kW), peak demand power (kW), and recorded time and date.
   6. Energy Summary Page: Circuit name, energy (kWh), reactive energy (kVARh), and time/date of last reset.
   7. Transformer Status Page: Transformer tag, coil temperatures, and cooling fan status.
   8. Specific Device Pages: Each individual communicating device shall display detailed, real- time information, as appropriate for device type.
      a. Display historical energy data that shall be logged automatically for each device, as appropriate for device type.
      b. Display historical data logged from each device in graphical time-trend plots. Value to be displayed on time-trend plot shall be user selectable. Time interval to be displayed on scale shall be for previous day or week.
   9. Export historical energy data to a PC or workstation through network using FTP (File Transfer Protocol). Format exported data in a CSV (Comma Separated Variable) file format for importing into spreadsheet applications.

J. Communications:
   1. Power monitor: Permanently connected to communicate via Modbus TCP via an 100 Base-T Ethernet.
   2. Local Plug-in Connections: RS-232 and 100 Base-T Ethernet.
   3. Monitor Display: Backlighted LCD to display metered data with touch-screen selecting device.

2.9 WORKSTATION HARDWARE

A. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Indoor installation in spaces that have environmental controls to maintain ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

B. Computer: Standard unmodified PC of modular design. CPU word size shall be 32 bytes or larger; CPU operating speed shall be at least 2.4 GHz.
   1. Memory: 2 GB of usable installed memory, expandable to a minimum of 4 GB without additional chassis or power supplies.
   2. Real-Time Clock:
      a. Accuracy: Plus or minus 1 minute per month.
      b. Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; automatic reset by software.
      c. Clock shall function for one year without power.
      d. Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.
   3. Serial Ports: Two RS-232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
   4. Parallel Port: Enhanced.
   5. LAN Adapter Card: 10/100-Mbps PCI bus, internal network interface card.
   6. Sound Card: For playback and recording of digital WAV sound files associated with audible warning and alarm functions.
   7. Color Monitor: PC compatible, not less than 21 inches (455 mm) widescreen, LCD type, with a minimum resolution of 1280 by 1024 pixels, non-interlaced.
   8. Keyboard: Minimum of 64 characters, standard ASCII character set based on ANSI INCITS 154.
   9. Mouse: Standard, compatible with installed software.
   10. Disk Storage: Include the following, each with appropriate controller:
      a. Minimum 120-GB hard disk, maximum average access time of 10 ms.
      b. PCMCIA slot with removable 500-MB media.
   11. Modem: 56,600 bps, full duplex for asynchronous communications. With error detection, auto answer/autodial, and call-in-progress detection. Modem shall comply with requirements in ITU-T v.34, ITU-T v.42, ITU-T v.42 Appendix VI for error correction, and ITU-T v.42 BIS for data compression standards; and shall be suitable for operating on unconditioned voice-grade telephone lines complying with 47 CFR 68.
   12. Audible Alarm: Manufacturer's standard.
   13. DVD/CD-ROM Drive:
      a. Nominal Storage Capacity: 650 MB.
      b. Data Transfer Rate: 1.2 Mbps.
      c. Average Access Time: 150 ms.
      d. Cache Memory: 256 KB.
      e. Data Throughput: 1 MB/second, minimum.
   14. Report Printer: Minimum resolution 600 dpi laser printer.
      a. Connected to central station and designated workstations.
      b. RAM: 2 MB, minimum.
      c. Printing Speed: Minimum 12 pages per minute.
      d. Paper Handling: Automatic sheet feeder with 250-sheet paper cassette and with automatic feed.
   15. Interface: Bidirectional parallel and universal serial bus.
   16. LAN Adapter Card: 10/100-Mbps internal network interface card.

C. UPS: Self-contained; Static Uninterruptible Power Supply for workstation computer, display monitor and printer.
   1. Size: Provide a minimum of 2 hours of operation of workstation station equipment, including 2 hours of alarm printer operation.
   2. Batteries: Sealed, valve regulated, recombinant, lead calcium.
   3. Accessories:
      a. Transient voltage suppression.
      b. Input-harmonics reduction.
      c. Rectifier/charger.
      d. Battery disconnect device.
      e. Static bypass transfer switch.

2.10 NETWOFK ALARM AND REMOTE NOTIFICATION INTERFACE

A. General: Replace legacy RS-232 ASCII alarm interfaces with Ethernet-based communication methods to ensure compatibility with modern IT infrastructure and long-term maintainability.

B. Alarm Communication Protocols:

1. System shall provide alarm/event notification via secure Ethernet-based protocols including:

   i. SNMP v3 traps for integration with facility IT network monitoring tools.

   ii. SMTP (secure email notifications) with TLS encryption.

   iii. SMS or push notifications via secure email-to-text gateway or approved cellular notification service.

2. Each alarm shall include a customizable message with device identification, alarm type, date, and time stamp.

C. Cybersecurity:

1. Alarm and notification features shall comply with NIST 800-82 and/or ISA/IEC 62443 guidelines for securing industrial control systems.

2. All communication shall be encrypted (TLS/SSL minimum).

D. Configuration:

1. System shall allow assignment of priority levels (critical, warning, informational) to alarms.

2. Alarms shall be user-configurable to initiate multiple notification methods simultaneously (e.g., SNMP trap and email).

E. Redundancy:

1. The system shall support redundant communication paths (dual Ethernet network connections or failover server architecture) to ensure delivery of alarm notifications.

2.11 LAN CABLES

A. Comply with Division 27 Section "Communications Horizontal Cabling."

B. RS-485 Cable:
1. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket, and NFPA 70, Type CMP.

C. Unshielded Twisted Pair Cables: Category 6 as specified for horizontal cable for data service in Division 27 Section "Communications Horizontal Cabling."

2.12 LOW-VOLTAGE WIRING

A. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
2. Ordinary Switching Circuits: Three conductors, unless otherwise indicated.
3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLING

A. Comply with NECA 1.

B. Wiring Method for wiring penetrating floor slabs: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

C. Wiring Method for wiring concealed in Walls, Partitions, and Inaccessible Ceilings: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

D. Wiring Method for surface mounted and other exposed circuits, including in Crawlspaces: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

E. Wiring Method for wiring concealed in accessible ceilings, install NRTL-listed plenum-rated cables supported on j-hooks.
1. For wall mounted devices: Install recessed device back boxes with conduit extended to above accessible ceiling according to Division 26 Section "Raceways and Boxes for Electrical Systems."

F. Install LAN cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.

G. Install cables without damaging conductors, shield, or jacket.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

B. Label each power monitoring and control module with a unique designation.

3.4 GROUNDING

A. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Assist factory-authorized service representative during testing and correct deficiencies as required. Report results in writing.
   1. Electrical Tests: Use caution when testing devices containing solid-state components.
   2. Continuity tests of circuits.
   3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.
      a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
      b. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
      c. Verify accuracy of graphic screens and icons.
      d. Metering Test: Load feeders, measure loads on feeder conductor with an RMS reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
      e. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

B. Correct Deficiencies, Retest and Report:
   1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace conductors, units, and devices as required to bring system into compliance.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Prepare a report that identifies panelboards, units, conductors and devices checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

C. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain system. Refer to Division 01 Section 01 79 00 "Demonstration and Training."
   1. Train Owner's personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment.
   2. Training Aid: Use approved final versions of software and maintenance manuals as

training aids.

3.7 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 26 09 13

SECTION 26 09 21 - DIGITAL LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. The intent of this set of specifications is to provide a complete, functional, intelligent, low-voltage lighting control system for the control of incandescent, low-voltage, LED, neon, cold cathode, fluorescent and HID lighting sources.

B. Where shown in the drawings, the contractor shall furnish and install a complete low-voltage lighting control system consisting of, but not limited to, relays, controllers, switch stations, and miscellaneous components as required for a complete, operational lighting control system.

C. Where applicable standards have been established, all items of equipment, individual components, and installation methods shall meet the requirements of these standards, including, but not limited to, Underwriter Laboratories, National Electrical Code, Federal Communications Commission, and any local or state codes that may be applicable.

D. Low voltage lighting control systems manufactured by the following manufacturers shall be considered providing they meet the requirements of these specifications and provide the quality and performance specified herein.

1. Intelligent Lighting Controls

E. Listing a manufacturer as acceptable does not in relieve the contractor from the responsibility for providing a lighting control system that meets all the requirements of these specifications.

F. All manufacturers shall submit to the specifying engineer a line-by-line compliance comparison between each specification requirement and the system being proposed.

G. Any ambiguities in the drawing or specification shall be brought to the attention of the specifying engineer for clarification.

1.2 QUALITY ASSURANCE

A. Factory Assembly: All relays, contactors, controllers, enclosures, switch stations and miscellaneous components shall be factory assembled and tested. All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and low-voltage control stations and/or network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.

B. Manufacturer: A minimum of 30 years of experience in the design and manufacture of lighting control equipment.

C. Component Testing: All system components and assemblies shall be individually tested before assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications before shipment.

D. NEC Compliance**:** All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.

E. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. UL/CUL Approval: All applicable equipment shall be UL/CUL listed under section 916 and shall bear labels indicating compliance.

G. FCC Emissions**:** All applicable equipment shall comply with FCC emissions standards specified in Part 15 and Part 68 where applicable for commercial applications and shall bear labels indicating compliance testing. Equipment not meeting these standards shall not be acceptable.

1.3 SUBMITTALS

A. The manufacturer shall provide an electronic copy of submittal drawings and data for approval before beginning the manufacture of equipment.

B. Hard copy submittal package shall be provided upon request.

C. Submittal package shall include, but not be limited to, the following. Submittals that do not contain all the information listed below will not be considered for approval.

1. Specifications Compliance: Submit a line-by-line comparison that describes the differences between each specification requirement and the equipment/systems being proposed. The comparison shall include a complete listing of how the proposed equipment/systems differ from those specified in size, quantity, quality, method of control, features and functions, control software functions, and installation requirements.

2. System Description: Supply as part of the submittal package a brief description of the lighting control system's major features and functions.

3. Bill of Materials: Provide as part of the submittal package a detailed itemized listing of all proposed equipment, including quantities and capacities for all major system components.

4. Product Data Sheets: Provide as part of the submittal package detailed product data sheets for all major system components.

5. Riser Drawing: Provide as part of the submittal package a system riser drawing of sufficient detail to indicate the relative placement of major system components and the required connections between each. Drawings shall be project specific. Generic or typical riser diagrams shall not be acceptable.

6. Control Schedules: Provide as part of the submittal package a complete control schedule spreadsheet for relay panels, Timers, Inputs, Groups, and Presets.

7. Switch Details: Provide as part of the submittal package complete switch details including color, gangs, buttons, plate style, plate colors, and engraving.

8. Warranty: Provide as part of the submittal package a complete written warranty.

1.4 WARRANTY

A. **Manufacturer's Warranty:** The manufacturer shall provide a written warranty that shall cover all lighting control equipment. The manufacturer shall agree to repair or replace any equipment that fails due to material or workmanship for a period of 5 years.

B. Relay Warranty: The manufacturer shall provide a separate written warranty that shall cover all lighting control relays within the lighting control system. The manufacturer shall agree to replace any relay that fails due to material or workmanship for a period of 5 years.

C. **Warranty Period:** The warranty period shall begin after the completion of the installation and the systems field start-up and training. Systems not provided with a field start-up begin upon receiving the product.

PART 2 – PRODUCTS

2.1 PROGRAMMABLE **LIGHTING CONTROL** PANELS

A. **Hardware** Features**:**

1. **Controller Back-Box:** Each programmable lighting controller shall be provided with a factory furnished; UL listed NEMA 1 enclosure designed for wall mounting. The backbox must be capable of being shipped ahead of the controller chassis insert to allow for rough-in of all electrical connections prior to receipt of the controller chassis insert.

2. Controller Chassis Insert: Each programmable lighting controller shall be provided with a factory or field-installable controller chassis insert. The Controller chassis insert shall contain all controller electronics, power supplies, relays, contactors, and other required components. Controller chassis inserts shall arrive at the project site completely pre-wired and require only the connection of lighting circuits and control devices.

3. Line Voltage / Control Voltage Separation: Each controller shall be provided with a mechanical barrier that separates all line voltage components and wiring from all control voltage components and wiring. An additional barrier may be installed that provides isolation between normal and emergency circuits where required.

4. Controller Covers: Each programmable lighting controller shall be provided with a dead front screw-held or hinged locking cover that is designed for either surface or flush mounting. Flush mount doors shall be provided with a trim ring. If a hinge-locking door is provided, it shall be provided with a slam-latch with 2 keys and door hooks to assist in mounting.

5. Controller Capacity**/Configurations:** Controllers shall be available in sizes to accommodate 4, 8, 16, 24, 32, 40, 48, 56, and 64 relay outputs. Controllers shall be available with the electronics in the center and voltage dividers with the lighting relays on the right/left sides.

B. Electrical**:**

1. **Controller Power Supply:** Each programmable lighting controller shall be provided with a dual-rated, UL-listed Class 2 transformer capable of either 120/277 VAC or 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.

2. Connections**:** All connections shall have clearly and permanently labeled termination points.

C. Controller **Electronics:**

1. **Controller CPU:** Each programmable controller shall have a CPU (Central Processing Unit) that shall provide all the programming and control functions for the entire controller.
2. Real-Time Clock: Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.
3. Relay Driver Module: Relay output cards shall be provided to expand the controller capability from 8 to 64 relay outputs in increments of 8. Electronics shall feature surge protection and optic isolation. It shall also provide an interface for mounting input boards.

4. Relay Control Switches**:** Controller shall contain push-button switches to turn all relays ON or OFF without the presence of any programming.

5. **Backup and Restore:** The controller shall be equipped with an internal memory backup and restore capability. It shall have the ability to back up all internal programming into additional onboard memory, verify present programming with backup, and restore programming.

6. Runtime Logging: The controller shall be equipped with memory to log the runtime of each relay. It shall be capable of storing up to 30 days or 1092 hours of data and be able to be exported in a delimitative format.
7. Non-Volatile Memory: Controller shall have a minimum of 4MB of nonvolatile EEPROM memory with data retention of >200 years and electrostatic discharge protection of >4000V.
8. Power Input Surge Suppression: The controller's 24VAC power input shall be equipped with double surge suppression to protect the electronics from transient over-voltages. Protection shall clamp over-voltages up to 123 volts.
9. Data Line Surge Suppression: The controller data line communications shall be equipped with transient voltage suppression protection that will protect the electronics from electrostatic discharge and other transient over-voltages. Protection shall clamp transients up to 8kV direct discharges and 15kV air discharges.
10. Data Line Communications: The controller shall be equipped with serial communications through RJ45 connectors for communicating on CAT-5 cable with other panels. It shall also be equipped with a separate local port for communicating with devices. The communications shall consist of 2-RS485 data lines.
11. USB Serial Communications: A USB port shall be provided for programming and interfacing the system with the use of a personal computer.
12. TCP/IP Communications: A TCP/IP port shall be provided for programming and interfacing the system with a computer over a network (LAN) or the internet (WAN).
13. Optional Module **Interface:** The controller shall contain 4 ports for interfacing optional modules which include communications and power. Optional modules shall be able to be mixed on each controller.

D. Switching and Control **Devices:**

1. Device Capacity: Each controller shall have an RJ45 data line port with power for up to 8 data line devices and shall be able to support up to 64 data line devices when using Power Supply Repeaters. A network of 254 panels would be able to support up to 16,510 devices. Each device shall have a unique address and shall be capable of being programmed to the applicable functions described in the Switched Input Types heading in this specification.

2. Data Line Media: The data line shall consist of RS485 communications protocol transmitted over CAT-5, CAT-5E, or CAT-6 Cable. The cable shall have male RJ45 connectors installed on each end for interfacing controllers and devices. Both daisy-chain and "T" (3-direction branching) of cable runs shall be permitted. "T" branching shall be accomplished by the addition of power supply repeaters.

3. Switch Stations: Data line switch stations shall be available in momentary push button (1-7 switches and pilots) and each switch shall have an associated pilot light. It shall be provided with optional dimming Raise and Lower buttons. Switches can be provided as Scene Multi-zone, Scene Stations, Multi-zone Stations, or Non-Dim Stations. Each button shall control any or all the relays in the lighting controllers or the dimmer outputs on the network. There shall be an option to program each pilot LED to indicate the state of any Relay, Group, Preset, Scene, and static ON or OFF. It shall also have the capability to reverse the status: LED is ON if the relay is OFF etc.

4. Digital Ceiling **Occupancy Sensor:** The Digital Ceiling Sensor shall be a low-profile ceiling mount sensor and provide dual-tech detection with passive infrared and overlapping passive acoustic sensing.

- **a.** Shall have two RJ45 ports for connection to a data line and shall be powered via the data line with no external power pack required.
- **b.** Shall have an auxiliary relay for connection to BAS system or power pack.
- **c.** Shall have a built-in daylight harvesting photosensor that can be enabled for full-range continuous daylight dimming control with 0-255 step resolution in the 0 to 1,800 fc range. The photosensor can be configured for open loop or closed loop daylight dimming and supports all standard ILC photocell sensor options.
- **d.** Shall support occupancy and vacancy modes, have an adjustable time-delay,

and be configurable over the digital bus for easy set-up and adjustment.

e. Sensitivity adjustments for passive infrared and acoustic can be independently adjusted to three different levels, including PIR-only mode, and shall have separate LED indicators for PIR and acoustic detection which can be independently disabled.

f. Automatic Gain Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises.

g. An initial PIR event shall be required to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut-off after 5 minutes of acoustic only detection.

h. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights.

5. **Digital Wall** Sensor **Switch:** The Digital Wall Sensor Switch station shall provide dual-tech occupancy sensing via passive infrared (PIR) and overlapping passive acoustic sensor, along with the programmable functionality of a digital switch station.

a. shall match the family of digital switches and be available in the same 6 colors and 12 button configurations supporting: 1-3 non-dim zones, 1-3 dimming zones, 1-3 scene capture and control, and 3 combinations of Scene/Multi-Zone functionality.

b. shall have field replaceable faceplates with color change kits and the option for individually replaceable buttons that can be custom engraved. The sensor switch shall also be field reconfigurable to change between different switch types.

c. Shall have two RJ45 ports for connection to a data line and shall be powered via the data line with no external power pack required.

d. Shall support occupancy and vacancy modes, have an adjustable time-delay, and be configurable over the digital bus for easy set-up and adjustment.

e. Sensitivity adjustments for passive infrared and acoustic can be independently adjusted to three different levels, including PIR-only mode, and the sensor switch shall have separate LED indicators for PIR and acoustic detection which can be independently disabled.

f. Automatic Threshold Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises.

g. An initial PIR event shall be required to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut-off after 5 minutes of acoustic only detection.

h. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights.

6. **Photocell Controllers:** The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs on the network.

7. Input Modules: The input module shall provide 4 inputs that accept momentary, momentary PB, and maintained switch closures. Each input shall be optically isolated and can accept dry contact closures or 12-24VDC signals. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs on the network. It shall provide four pilot outputs that provide the true status of relays, groups, and presets. It shall be installed in the control panel or remotely mounted.

8. Disable Key Switch: The disable switch shall provide an RJ45 connector that shall disable all devices down line with the closure of a key switch. It shall also provide two

RJ45 connectors to pass data through. It shall indicate with an LED when the disable switch is active.

9. Occupancy Sensor Module: The Occupancy Sensor Module shall provide 800mA of power for 24VDC hardwired motion sensors. It shall have 8 independent inputs that shall be able to interface multiple sensors. Each input shall control any or all of the relays in the lighting controllers or the dimmer outputs on the network. It shall have the ability to set AND/OR conditional logic. It shall be installed in the control panel or remotely mounted.

10. 0-10V Dimmer Output Module: The 0-10VDC dimmer output module shall be designed to control dimmable ballasts or other 0-10VDC devices. Each module shall have 4 independent output channels that can control up to 200 devices per output at .5mA per device. It shall have the capability to vary its level 256 steps between 0 and 10VDC. It shall be able to respond to photo controllers, switch inputs, DMX512 signals, and timers. Each output shall be galvanically isolated up to 1500V to protect electronics. It shall be installed in the control panel or remotely mounted.

11. **Graphical Touch Screen Control Station:** The Touch screen control station shall display the status and control the lighting control panel relay outputs via pre-programmed control objects on standard or custom bitmap screens.

E. Special **Purpose Modules:** The following special-purpose controller nodes shall be available. Four modules shall be permitted per controller.

1. **BACnet Control:** This module shall communicate directly to the lighting controller through serial communications from the BAS system using BACnet MSTP or BACnet IP protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.
2. DMX Control: This module shall support the control of relays using the standard USITT DMX512 protocol used by theatrical lighting systems. Each relay in the lighting panel shall be configured to be controlled by any DMX channel. It shall contain a frame filter that can be set from 1 – 16 frames. It shall have a priority setting for switch inputs or DMX signals. It shall have the capability to control any 0 – 10V dimming output throughout the network. It shall display current DMX levels from the keypad.
3. DMX Driver: This module shall send DMX signals from the lighting control panels using the standard USITT DMX512 protocol used by theatrical lighting systems. Each module added to the panel shall control up to 64 channels. Each dimming output channel shall be able to be mapped to 1-512 DMX channels. It shall be 1 to 1 mapped or programmed with free software. It shall be installed in the control panel or remotely mounted.

4. Modbus Control: This module shall communicate directly to the lighting controller through RS485, RS232, or TCP serial communications from the BAS system using Modicon Modbus RTU or ASCII protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.

5. **N2 Control:** This module shall communicate directly to the lighting controller through serial communications from the BAS system using the Metasys-N2 protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.

6. Protocol Input Control: This module shall allow serial communications from a Modbus, N2, or BACnet network. It shall be capable of emulating switches or photocells for direct control and status of relays, dimmers, or motor controls.

F. **Programming:** Programmable controllers shall be capable of being programmed, monitored, backed up, or controlled through any of the below methods. All programming changes shall take effect immediately as they are programmed and shall not suspend or disable switches or other system functions. The same functions shall be available for any of

the connection types.

1. **Local Keypad and Display:** The system user shall be able to program, monitor, and control any of the controller features and functions through the use of a simple menu-driven self-prompting user interface consisting of a 4-line 20-character backlit LCD display and 8 selection keys that change function based on the current operating mode.
2. USB Serial Direct Connect: The system user shall be able to program, monitor, or control any of the controller features and functions utilizing Windows-based graphical user interface software using a USB port from a PC.
3. TCP/IP Connect: The system user shall be able to remotely program, monitor, or control any of the controller features and functions utilizing Windows-based graphical user interface software using a PC with TCP/IP on a LAN or WAN.

G. Diagnostics**:** Programmable controllers shall have the ability to do the following diagnostics.

1. **Power Status:** Each programmable lighting controller shall be provided with an LED on the controller and each output board shall indicate that power is present.
2. Keypad: System users shall be able to view thru the keypad the status of any relay, input, group, or preset and force any ON or OFF.
3. Software: System users shall be able to view thru the software the status of any relay, input, group, or preset and force any ON or OFF. It shall also be able to scan the network for devices and controllers and then poll them to verify network quality.
4. Relay Cycle Test: The controller shall have a cycle test for relays to turn them off/on/off and then return them to the original state to verify proper operation. It shall display the results for each relay for turning the relay ON and OFF.
5. Device Finder: It shall have the capability through the keypad to find devices, dimmer devices, and motor devices on the network.
6. Switch Test Mode: Shall be able to enter switch test mode, where normal control is disabled, and switch input activation will only control input status LEDs.
7. Demo Clock: It shall have the ability to speed the clock's time by 10, 30, or 60 times for testing timer functions.

H. Power Failure and Power-Up: Each controller shall be provided with circuitry that shall automatically shut down the controller when the incoming power fails to be delivered to the within the required limits. When power is returned to the controller, one of the following power-up modes will be implemented for each controlled relay output in the system.

1. **No Action:** Upon restoration of incoming control power, the controller electronics shall be restarted and resume normal operation and all circuits will be maintained in the condition they were last in.
2. Turn ON: Controller shall turn the selected relay output to the ON state after power-up.
3. Turn ON if **Input Closed:** Controller shall turn the selected relay output to the ON state after power-up if the local input selected is closed. It shall be able to monitor any input.
4. **Turn OFF:** Controller shall turn the selected relay output to the OFF state after power-up.
5. **Turn** OFF if Input Closed: Controller shall turn the selected relay output to the OFF state after power-up if the local input selected is closed. It shall be able to monitor any input.
6. On if Open Time, OFF if Closed Time: Controller shall turn the selected relay output to the ON state during Open hours and shall turn selected relay outputs to the OFF state during Closed hours. This shall be used in conjunction with OPEN/CLOSED timers.
7. OFF if Open Time, ON if Closed Time: Controller shall turn the selected relay output to the OFF state during Open hours and shall turn selected relay outputs to the ON state during Closed hours. This shall be used in conjunction with OPEN/CLOSED timers.
8. Time of Day: Controller shall turn the selected relay output to the ON or OFF state based on the time of day in 30-minute increments for every day of the week.

I. **True Relay Status Feedback:** Each controller shall be provided with circuitry that shall monitor the actual status of each relay via pilot contacts mechanically linked to the relay main contacts.

J. Switch **Input Details:** All switch inputs shall have the following options:

1. **Input Flexibility:** Each switch input shall accept a 2 or 3-wire maintained or momentary switch. It shall be capable of accepting a dry contact, open collector closure, or a 12-24VDC signal. Each switch shall be able to have 2 switch types associated with it in an A/B form.
2. Input to Output Programmability: Any switch input shall be programmed to control any or all the controller's relay outputs without limitations in the network.
3. Input Logic Conditionals: All switch inputs shall have 2 conditionals that add a logic "AND" or "OR" dependent on a relay on, a relay off, an "on" input opened or closed, and an "off" input opened or closed. It shall also have a priority level setting.
4. Input Active Times: All switch inputs shall have a time-of-day or open/close time of action that can change the switch type on the time of day every 30 minutes or per open/closed times.
5. Input Types**:**
   a) **Momentary ON/OFF:** When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON. When momentary contact is made between OFF and COM, relay outputs controlled by this input shall be turned OFF.
   b) Momentary ON/OFF w/Blink: When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON. When momentary contact is made between OFF and COM, relay outputs controlled by this input shall blink and postpone being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning it OFF. If an ON command is received during the blink alert time, relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.
   c) Momentary Push-Button ON/OFF: When momentary contact is made between the ON and COM, relay outputs controlled by this input are turned ON and OFF alternately, based on the current state, each time contact is made.
   d) Momentary Push-Button ON: When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON.
   e) Momentary Push-Button OFF: When momentary contact is made between ON and COM, relay outputs controlled by this input shall be turned OFF.
   f) Momentary Push-Button Toggle: When momentary contact is made between ON and COM, relay outputs controlled by this input shall toggle from the present state.
   g) Maintained ON/OFF: When contact is made between the ON and COM, relay outputs controlled by this input are turned ON. When contact is broken between ON and COM, relay outputs controlled by this input are turned OFF.
   h) Maintained Multi-way: When contact is either made or broken between the ON and COM, relay outputs controlled by this input will be toggled between ON and OFF conditions. This function shall be similar to that of standard 3 and 4-way switches.
   i) **Maintained ON/OFF w/Blink:** When contact is made between the ON and COM, relay outputs controlled by this input are turned ON. When contact is broken between ON and COM, relay outputs controlled by this input shall blink and postpone being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning OFF. If an ON command is received during the blink alert time, relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.
   j) **Timed ON:** The timed-ON input shall operate either from the input closure or

open. If programmed to operate from the closure, the relays turn ON when the input closes and turn OFF after the time duration. The relays do nothing when the input opens. If programmed to operate from the open, the relays turn ON when the input closes and remain ON. When the input opens, the relays turn OFF after the timed-ON duration.

k) HID Bi-Level: This feature requires the configuration of ON/OFF relay outputs and HI/LOW relay outputs. The first momentary contact between ON and COM sets the ON relay outputs to ON and the HI/LOW outputs to HI (for at least 15 Minutes). The second contact switches the HI/LOW outputs to LOW. Additional contact closures will toggle the HI/LOW relay outputs. The cycle then repeats until momentary contact is made between the switch input OFF and COM. then the ON/OFF outputs and HI/LOW outputs are turned OFF.

l) Two-Step Alternating Sequence: The first time the switch is activated, relay outputs programmed as “Group A” are turned ON, and relay outputs programmed as “Group B” are turned OFF. The second time the switch is activated, “Group A” relay outputs are turned OFF, and “Group B” relay outputs are turned ON. The third time the switch is activated, the pattern begins again at step one.

m) Four-Step Alternating Sequence: The first time the switch is activated, relay outputs programmed as “Group A” are turned ON, and relay outputs programmed as “Group B” are turned OFF. The second time the switch is activated, “Group A” relay outputs are turned OFF, and “Group B” relay outputs are turned ON. The third time the switch is activated; both “Group A” and “Group B” relay outputs are turned ON. The fourth time the switch is activated; both “Group A” and “Group B” relays are turned OFF. The fifth time the switch is activated, the process begins again at step one.

n) Set Preset: When momentary contact is made between the ON and COM, the selected preset scene will be activated.

o) Set Scene: When momentary contact is made between the ON and COM, the selected scene will be activated.

p) Force Timer: When momentary contact is made between the ON and COM, the selected timer will be activated.

K. Timer Functions: Each of the programmable lighting controllers shall have the described timer options listed below for the relay outputs.

1. Time-of-Day Timers: Each programmable lighting controller shall be provided with a minimum of 128 available timers (scheduled events) for use in developing time-of-day automated schedules. Each timer shall have the ability to turn any or all relay outputs ON or OFF at any time in 1-minute increments. Timers shall be day-of-week selectable and may be programmed to activate on any combination of days of the week. Each shall be capable of being programmed to be enabled or disabled for any day of the calendar year.

2. Astronomical Scheduling: Each controller shall contain an astronomical time clock that shall calculate sunrise and sunset times based on the geographical latitude and longitude positioning. Sunrise and sunset times may be used as activation times for any system timer. In addition to sunrise and sunset time activation, the control shall be capable of programming activation time before and after these times based on an offset of 1-999 minutes.

3. Open/Closed Time Control: The user shall also have the option of controlling relay outputs in relation to the Open/Closed times of the facility. The Open/Closed times may vary for different days of the week and may be programmed for each day of the year. In addition to Open/Closed time activation, the control shall be capable of programming activation time before and after these Open/Closed times based on an offset of 1-999.

4. Off-Hour Sweeps: The system shall also support after-hours OFF sweeps of selected relays or groups of relays at user-defined one, two, or three-hour intervals.

5. Automated **Circadian Rhythm Control:** The system shall be capable of providing Automated Circadian Rhythm color shifting via a 0-10VDC dimming output.
   - **a.** Each dimming channel shall support up to a 100mA dimming load and be galvanically isolated up to 1500V to protect electronics.
   - **b.** The Automated Circadian Rhythm dimming curve shall be able to vary its level 256 steps between 0 and 10VDC and smoothly change colors between setpoints with no abrupt color changes. The system shall be able to automatically turn fixtures on to color temperature specified by the Automated Circadian Rhythm color shifting program.
   - **c.** The system shall have a default Automated Circadian Rhythm dimming curve that automatically adjusts start/stop times via astronomical time clock. Additionally, the system shall have the option for a user-defined dimming curve with static start/stop times.
   - **d.** The system shall provide the option for local controls to be capable of temporarily overriding the current circadian rhythm color. The manual override duration shall not be reliant upon nor limited by the time-of-day setpoints in the Automated Circadian Rhythm color shifting program. The system shall be capable of instantly flipping back and forth between manual override mode and Automated Circadian Rhythm mode without being reliant upon nor limited by the time-of-day setpoints in the Automated Circadian Rhythm color shifting program.
   - **e.** The system shall be capable of flipping between manual override mode and Automated Circadian Rhythm mode via inputs from 3rd party systems such as BAS, Fire, Security, AV etc.
   - **f.** The system shall be capable of providing multiple programming options for how/when to revert back to the Automatic Circadian Rhythm mode including the ability to revert back to the Automated Circadian Rhythm mode once a load is turned off and then back on.

L. **Relay Output OFF Options:** Each relay shall have the option to control the relay OFF in a certain way other than the default OFF.

1. **Single Blink Alert:** Each relay output within the programmable lighting controller shall be individually programmable to blink and postponed prior to being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning OFF with a timer OFF sweep to warn occupants of the upcoming OFF event. If an ON command is received during the blink alert time, the relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.
2. **Double Blink Alert:** Each relay output within the programmable lighting controller shall be individually programmable to blink and postponed prior to being turned OFF and then blinked 1 minute before turning OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice for each alert to warn occupants of the upcoming OFF event. If an ON command is received during the blink alert time, the relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.
3. **HID Delay:** Each relay output within the programmable lighting controller shall have the ability to be controlled like a Single Blink Alert as described above but without the blink, alert to prevent damage to HID lamps.
4. **Alarm ON:** Relays shall be capable of performing a momentary ON function. The ON function shall be programmable from 1 to 99 seconds.
5. Alarm OFF: Relays shall be capable of performing a momentary OFF function. The OFF function shall be programmable from 1 to 99 seconds.
6. Alarm Pulsed ON: Relays shall be capable of being cycled ON and OFF at 1-second intervals and returning to the OFF state. It shall be programmable from 1 to 90 seconds.
7. Alarm Pulsed OFF: Relays shall be capable of being cycled OFF and ON at 1-second intervals and returning to the ON state. It shall be programmable from 1 to 90

seconds.

8. Automatic Control Switch-OFF: Relays shall be capable of being cycled OFF for 5 seconds and then returned to the ON state for controlling Sentry or AS110 switches.
9. Automatic Con**trol Switch-Blink:** Relays shall be capable of being cycled OFF for 1.5 seconds and then returned to the ON state for controlling Delay-OFF mode on AS110 switches.

M. **Presets:** The lighting controller shall support up to 256 user-defined presets of ON/OFF relay patterns. The presets shall be invoked by a switch or timer actuation.

N. **Descriptive Names:** The system shall support the optional assignment of descriptive names (up to 10 characters) to the lighting controller, relay outputs, relay groups, inputs, timers, and presets. These names shall be able to switch from custom names to default names.

O. Password **Protection:** Each Programmable controller shall have user-definable 6-digit alphanumeric passwords with 2 levels of access. Level 1 is control & edit. Level 2 is control only.

P. Networking**:**

1. **Network Capacities:** In addition to the data line devices mentioned in Section D, Controllers shall be linked together on the data line to form a Local Area Network (LAN) of up to 254 controller nodes.
2. Network Features: The network manager shall allow the connection of up to 254 controllers and 254 data line devices (on top of the 64 devices per panel) and provide USB communications. It shall have a high-speed scanner, 4 gateway device ports, power for devices, and TCP/IP.
3. Network Universe: The network of panels shall be capable to connect to other networks over a network (LAN) or over the internet (WAN) to interconnect multiple systems.
4. Network Gateway**:** The following special-purpose gateways shall be available and provides network-wide control from a single point for its specialized function:
   a) **Modbus** Control: The Modbus gateway shall support communications from the BAS system using Modicon Modbus protocol from a single-point connection. All network input status, relay status, and control shall be supported.
   b) N2 Control: The N2 gateway shall support communications from the BAS system using a Metasys-N2 protocol from a single-point connection. Network-wide group status and control shall be supported.
   c) BACnet Control: The BACnet gateway shall support communications from the BAS system using BACnet MSTP or BACnet IP protocol from a single point connection. It shall allow up to 500 single relays, 100 multiple relays, 48 groups, and 48 presets.
   d) Advanced BACnet **Control:** The Advanced BACnet gateway shall support communications from the BAS system using BACnet IP protocol from a single-point connection. It shall allow up to per panel; 20 Relays, 20 Dimmers, 16 devices (128 maintained inputs), 64 Groups/Presets, and 48 Scenes.
5. **BAS System / Lighting Control System:** Programmable lighting controllers interfaced with other building systems must remain functional and continue to process all programmed commands, including time schedules and local switching.

Q. **Runtime Logging and Trending:** Each lighting control panel shall be capable of logging Runtime and Trending data for each relay. This data shall be able to be harvested and exported from the entire system.

1. **Runtime Logging:** The controller shall be able to internally log the runtime of each relay for up to 30 days. This data shall be able to be harvested with a personal computer at 1-minute intervals.
2. Logging and Trending Software: Runtime Logging and Trending software shall be available for harvesting data from the lighting control panels. It shall have a dedicated

personal computer connected to the system through a LAN or USB cable to the panel or network controller.

- **a)** **Load Configuration:** Each relay in the system shall be able to have a wattage load assigned to it to represent the actual load on the relay. Loads shall be able to be named, or names shall be exported directly from the system programming software.
- **b)** Combined Loads: Up to 254 combined relay loads from any panel in the network shall be allowed, for total wattage recording of areas in the facility. Combined loads shall be able to be named for identification in reports and graphs.
- **c)** Daily or Monthly Usage Report: The software shall be able to generate spreadsheet reports in a daily or monthly format for each relay or combined relays in the system.
- **d)** Export Data: The compiled reports shall be able to be exported to a .csv file. These files when exported shall be coded for the year, month, and date.
- **e)** Daily or Monthly Usage Graphs: The software shall be capable of generating usage graphs in a daily or monthly format for each relay or combined relays in the system.
- **f)** Printing: Daily or monthly usage graphs shall have the capability to be directly printed from the software.
- **g)** Live Usage Graphs: The software shall have 1 to 9 live usage meter dials to display the present wattage of combined loads.
- **h)** Calendar **View:** It shall provide a full-year calendar that shall display the number of calendar events.

R. **Graphical Control Interface:** The software shall be a Windows-based graphical interface that allows monitoring and control of panels using icons on custom or standard graphical screens.

1. Graphical **Background Screens:** Graphical background screen shall consist of any bitmap image with any resolution or number of colors. There shall be virtually limitless numbers of screens with a limit to the capacity of the computer.
2. Multiple **Interfaces:** It shall support an unlimited number of satellite computers controlling the same system. (1 Main computer, multiple remote computers).
3. **Virtual PC:** It shall support web access via a virtual computer.
4. **Fault** Log**:** It shall log and notify of any relay or network faults.
   - **a)** The software shall monitor itself and restart if there is a system communication issue.
   - **b)** It shall automatically send an e-mail to the user(s) notifying them of the problem.
   - **c)** An alarm shall report if a relay doesn't turn on/off correctly with real-time status updates.
   - **d)** It shall log the loss of communications of each network and every node per network. It shall log when it goes offline and when it goes back online.
5. **Control Icons:** Control icons shall be unlimited per screen and shall be chosen from an extensive library. It shall be able to use custom control icons that can be created and saved as BMP, JPEG, or GIF images. Control icons shall be able to be placed anywhere on the screen and edited at any time. Control icons shall control relays, LL Groups, LL Presets, LL Scenes, LL Timers, or dimmer scenes.
6. **Control** Options**:** It shall have the following capabilities for control and setup.
   - **a)** **Flood:** It shall have the capability to flood areas or change the color of a defined section of the screen (floor plan) for depicting On/Off states.
   - **b)** Sounds**:** It shall be able to trigger custom sound WAV files for on/off triggers.
   - **c)** **Verify:** There should be settings to verify control action and relay sweep commands.
   - **d)** **Toggle:** This shall be a selectable action for relays which shall include always, never, or selective relays.
   - **e)** **Sweep** Enable: There shall be an option for a sweep command.
   - **f)** Grid: A grid shall be available for the design and placement of icons on the

screens. This shall be adjustable for size and color, plus it shall be able to allow a snap-to-grid feature.

g) Tool Tips: It shall have a Tool Tips option that displays text when hovered over an icon.

h) Extra Loads: It shall have the capability to add extra loads to a single relay control icon.

i) Import: It shall have the capability to import settings and objects.

j) Synchronize Screens: Remote computers shall have the capability to synchronize screens with a single button push.

k) Text Icons: Text icons can be added to any screen and shall be able to be placed anywhere on the screen and edited at any time. They should be adjustable for size, color, font, and transparency.

l) UDP Command**:** It shall support UDP command strings for special functions in the system.

7. **Navigation Icons:** These shall have navigation buttons for going from one screen to another. These icons shall have the capability to be Global and be visible on all screens. Icons shall have standard sizes that shall be editable for color, size, and font. It shall be able to use custom control icons that can be created and saved as BMP, JPEG, or GIF images. Navigation icons shall be able to be placed anywhere on the screen and edited at any time.

8. **Sequence Control:** It shall be able to sequences with up to 16 transitions over a 12-hour period for events. It shall be able to turn on/off single relays, LL Groups, set a Preset, or LL Scenes in a sequence.

9. **Dimmer** Control**:**

a) **Single Slider:** Slide dimmers shall be available for single control and/or status of a 0-10V output or an sACN slot.

b) **Pop-up Multi-Sliders:** It shall have up to 16 pop-up control sliders. Each shall be able to be linked to any dimmer(s) in the system. It shall have the capability to have a slider to control all dimmers, direct or proportional.

10. **Security** and **User Access:**

a) It shall have an Administrator lock-out for specific screens and for specific users during an event in the facility.

b) It shall support up to 5 levels of user security.

c) There shall be advanced managed user access for up to 32 users.

d) A settable administrator timeout shall be settable from 15 minutes to 4 hours.

e) The Administrator shall be able to assign users' access and passwords.

11. **Multi Network:** It shall be able to link together up to 32 networks with up to 254 nodes per network to operate as one system.

12. **Schedules:** It shall have programmable schedules that send commands to each network and each node in the system.

a) It shall have up to 4000 programmable schedules.

b) It shall automatically control relays, groups, scenes, presets, or trigger a sequence.

c) Schedules shall be based on a fixed time, shared time, or before-at-after sunrise-sunset.

d) Latitude/Longitude and time-zone settings shall be settable with adjustable DST settings.

e) It shall have a search option for all schedules that include relays, LL Groups, LL Presets, and Sequences.

13. **Runtime Monitoring:** It shall incorporate the "Runtime Logging and Trending" software as specified in section "Q".

14. Diagnostics **Dashboard:** It shall have a tool to monitor all the relays/devices in the system.

15. **Serial** Interfaces**:**

a) **sACN Interface:** It shall have the capability to view sACN via (no interface needed for viewing) and control sACN through an Interactive Technologies

CueServer Interface optional add-on.

b) DMX Control: It shall have an optional DMX output for lighting fixtures and ILC dimmer outputs

c) BACnet IP: It shall have an optional serial input for status and control. It shall have up to 750 control points and status for Groups, Presets, or Sequence. It shall have an export to .csv file for documentation.

S. Emergency **UL924 Lighting Controller Option:** Each lighting controller shall have the option to provide an emergency lighting bypass without the use of external devices. It shall be UL924 listed and clearly marked.

1. **Bypass Control:** If normal power is lost, if selected, the panel shall force the EM relays to the ON position. It shall also force any 0-10V dimming to 100%.

2. **Control Type:** It shall have the option to select the EM relay control for Force On, Force Off, and No change.

3. **Phase Monitoring:** It shall be able to monitor up to three phases of normal power. Upon loss of any phase, the panel will go into an emergency state. It shall be selectable for each phase monitored. It shall be able to monitor 120/277 VAC circuits.

4. Isolation: It shall have barriers to separate Normal and Emergency circuits.

5. Remote Testing**:** It shall be provided with input for remote testing. It shall also be provided an output for driving a remote status LED.

2.2 LIGHTING ROOM CONTROLLERS:

A. **Room** Controller**:** Each controller shall be designed to be remotely installed and provide control of 4 remote load control relays. This controller shall have the same programmable features as the Programmable Lighting Control Panels.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with removable screw cover, 1/2" nipple, and pre-drilled mounting holes.

2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.

4. Controller Power Supply: Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.

5. High Voltage Connections: Each controller shall be provided with 6” wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.

6. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data line and relay connections, and push-to-connect connectors for occupancy and photo sensor inputs. All connections shall have clearly and permanently labeled termination points.

7. **Occupancy Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controller or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:

- 200mA w/4 devices connected to the controller
- 160mA w/5 devices connected to the controller
- 120mA w/6 devices connected to the controller
- 90mA w/7 devices connected to the controller
- 60mA w/8 devices connected to the controller

8. **Photocell Inputs:** It shall have 2 inputs for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all

relays/dimmers in the lighting controller.

9. Local Data Line Port: It shall provide an RJ45 data line port with power for up to 8 data line devices. It shall be able to support up to 61 data line devices when using Power Supply Repeaters.
10. Real-Time Clock: Each controller shall be provided with its own Real-Time Clock used to perform all time-related functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second. Time clock functions shall include the time of day, day of the week, date, and automatic DST and leap year adjustments. DST shall be adjustable with an enable/disable feature. It shall be protected against loss of time for a period of up to 45 days without power. Systems relying on a single clock device shall not be acceptable.
11. **Pre-Configured Programs:** Each controller shall have up to 16 selectable pre-configured lighting application programs and 1 default contractor program.

B. **Room Controller:** Each controller shall be designed to be remotely installed and provide control of 4 load control relays. This controller shall have the same features as the Programmable Lighting Control Panels excluding add-ons and naming.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with removable screw cover, 1/2" nipple, and pre-drilled mounting holes.
2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. Controller Power Supply: Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.
5. High Voltage Connections: Each controller shall be provided with 6” wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
6. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, and the relay connections. It shall also be provided push-to-connect connectors for occupancy sensors, and photo sensor inputs. All connections shall be made to clearly and permanently labeled termination points.
7. Occupancy **Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 200mA w/4 devices connected to the controller
8. **Photocell Inputs:** It shall have 2 inputs for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.
9. Local Data Line Port: It shall provide an RJ45 data line port with power for up to 4 data line devices.

C. **Integrated -4 -8 Relay Controller:** Each controller shall be designed to be remotely installed and provide control of 4 or 8 integrated load control relays. This controller shall have the same features as the Programmable Lighting Control Panels.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with removable screw cover, 1/2" knockouts, and pre-drilled mounting holes.
2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers

without this rating shall be unacceptable.

3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. Controller Power Supply: Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
5. Relay Ratings**:** It shall be provided with 4- or 8- 50A load relays that shall be de-rated for 16 amps for durability. It shall control 16A for each set of 4 outputs:
   - 16A, 120/277VAC Electronic Ballast (LED)
   - 16A 120/277VAC Tungsten
   - 1/4 HP @ 120 VAC Motor Load
6. **High Voltage Connections:** Each controller shall be provided with terminal blocks for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
7. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, and photo sensor connections. It shall also be provided push-to-connect and screw connectors for occupancy sensors, dimming, and low-voltage inputs. All connections shall be made to clearly and permanently labeled termination points.
8. Occupancy Sensor Inputs: It shall have 4 independent inputs able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 60mA w/4 devices connected to the controller
   - 50mA w/5 devices connected to the controller
   - 40mA w/6 devices connected to the controller
   - 20mA w/7 devices connected to the controller
   - 0mA w/8 devices connected to the controller
9. **Photocell Inputs:** It shall have 1 input for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.
10. **Local Data Line Port:** It shall provide an RJ45 data line port with power for up to 8 data line devices. It shall be able to support up to 61 data line devices when using Power Supply Repeaters.
11. Dimming: It shall be provided with 4 or 8 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.
12. Real-Time Clock: Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.
13. **Pre-Configured Programs:** Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

D. Integrated **2 Relay Controller:** Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.

1. **Enclosure:** Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½" nipple and mounting tab.

2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
5. Relay Rati**ngs:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
   - 16A, 120/277VAC Electronic Ballast (LED)
   - 20A 120/277VAC General
   - 1/4 HP @ 120 VAC Motor Load
6. **High** Voltage Connections: Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.
7. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.
8. Occupancy **Sensor Inputs:** It shall have 1 input with power provided for the occupancy sensors. The input shall control any or all the relays in the lighting controller or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 70mA w/1 device connected to the controller
   - 60mA w/2 devices connected to the controller
   - 50mA w/3 devices connected to the controller
   - 40mA w/4 devices connected to the controller
9. Photocell Inputs: It shall have 1 input for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.
10. Local Data Line Port: It shall have an RJ45 data line port with power for up to 8 data line devices. It shall be able to support up to 61 data line devices when using Power Supply Repeaters.
11. Dimming: It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.
12. Pre-Configured **Program:** It shall have a pre-configured default plug-n-play program, with the option for a customizable job-specific program.

E. **Integrated 2 Room Controller:** Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.
   1. **Enclosure:** Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½" nipple and mounting tab.
   2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
   3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
   4. Controller **Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
   5. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
      - 16A, 120/277VAC Electronic Ballast (LED)

- 20A 120/277VAC General
- 1/4 HP @ 120 VAC Motor Load

6. **High Voltage Connections:** Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.
7. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.
8. Occupancy Sensor **Inputs:** It shall have 1 input with power provided. The input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 70mA w/1 device connected to the controller
   - 60mA w/2 devices connected to the controller
   - 50mA w/3 devices connected to the controller
9. **Photocell Inputs:** It shall have 1 input for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.
10. Local Data Line Port: It shall provide an RJ45 data line port with power for up to 3 data line devices.
11. Dimming: It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.

    Pre-Configured Programs: Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

2.3 LIGHTING **CONTROL RELAYS:**

A. **Single Pole Relay:** It shall be designed for controlling high-inrush single pole lighting circuits. It shall employ 4 latching nickel-silver contacts.

1. **Listing:** Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.
2. Labeling: Lighting control relays shall bear labels for relay current and SCCR ratings.
3. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
4. SCCR: Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.
5. Relay Ratings: It shall be rated for the following:
   - 16A, 120/277/347 VAC Electronic Ballast (LED)
   - 40A 120/277/347 VAC Ballast
   - 40A 120/277/347 VAC Tungsten
   - 1/5 HP @ 120 VAC Motor Load
   - It shall be suitable for plug-loads
6. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
7. Auxiliary Contacts: Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.
8. Mounting: Relays shall be capable of panel mounting.
9. Lock-Out: Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.
10. Actuator: Relays shall be equipped with a manual actuator switch for turning the relay

ON or OFF along with status indication.

B. **2 and 3 Pole Relay:** It shall be designed for controlling high-inrush 2-, 3-pole lighting circuits. Each pole shall employ 4 latching nickel-silver contacts.

1. Listing: Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.

2. Labeling: Lighting control relays shall bear labels for relay current and SCCR ratings.

3. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.

4. SCCR: Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.

5. Relay **Ratings:** Each relay shall be designed for the control of 208, 240, and 480 VAC lighting loads at the following per pole.

- 16A, 120/277/347 VAC Electronic Ballast (LED)
- 40A 120/277/347 VAC Ballast
- 40A 120/277/347 VAC Tungsten
- 1/5 HP @ 120 VAC Motor Load
- It shall be suitable for plug-loads

6. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

7. Auxiliary Contacts: Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.

8. Mounting: Relays shall be capable of panel mounting.

9. Lock-Out: Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.

10. Actuator: Relays shall be equipped with a manual actuator switch for turning the relay ON or OFF along with status indication

11. Mechanical **Link:** Poles within the relay shall be electrically isolated but mechanically linked so as to open and close together without the possibility of one pole being closed while the other remains open. Systems that utilize two single-pole relays to accomplish this function are not acceptable.

C. Single **Pole Relay w/Dimming:** The remote relay shall be designed to be mounted to a junction box or fixture and shall control 1 load up to 16 Amp circuit and 0-10V dimming.

1. **Listing:** Lighting control relays shall be individually UL and CUL listed and shall bear labels indicating compliance.

2. Plenum: Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.

3. **Labeling:** Lighting control relays shall bear labels for relay current ratings.

4. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.

5. SCCR: Lighting relays shall have an SCCR rating of 5,000 amps up to 277 VAC.

6. **Relay Ratings:** It shall be rated for the following:

- 16A, 120/277/347 VAC Electronic Ballast (LED)
- 16A 120/277/347 VAC Ballast
- 16A 120/277/347 VAC Tungsten
- 16A 120/277/347 VAC Resistive
- 1/5 HP @ 120 VAC Motor Load
- It shall be suitable for plug-load

7. **Dimming:** Shall be able to control 0-10V dimming ballast and be able to sink up to 100 mA.

8. Latching: Lighting control relays shall be designed with a latching mechanism that

shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

9. Mounting: It shall have a ½" nipple for mounting to an enclosure or fixture

D. EM Dimming Relay with Emergency Bypass: The EM relay shall be able to control 1 normal and 1 emergency 0-10V dimmable load together, providing UL924 bypass operation of the emergency load during a loss of normal power It shall be designed to be mounted to a junction box or fixture.

1. Listing: Lighting control relays shall be individually UL/CUL/UL924 listed and shall bear labels indicating compliance.

2. Plenum: Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.

3. Labeling: Lighting control relays shall bear labels for relay current ratings.

4. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.

5. SCCR: Lighting relays shall have an SCCR rating of 5,000 amps up to 347 VAC.

6. EM Function: It shall have one normal power relay and one EM relay. Both shall be controlled by a controller. Upon loss of power, the EM relay shall be forced to the ON state. During the EM state, 0-10 V dimming shall be forced to 100%.

7. Relay Ratings: It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:

- 16A, 120/277VAC Electronic Ballast (LED)
- 20A 120/277VAC General
- 1/4 HP @ 120 VAC Motor Load
- It shall be suitable for plug-load

8. Latching: Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

9. Mounting: It shall have a ½" nipple for mounting to an enclosure or fixture.

10. Test Button: It shall have a test button for testing the EM function.

11. Test Input: It shall have an input for testing the EM function from a remote location.

2.4 STANDALONE **CONTROL DEVICES:**

A. Power Pack: Each Power Pack shall provide standalone on/off and 0-10V dimming control of a single 20A (16A LED) load and provide 350mA of power for connected low voltage devices.

1. Enclosure: Each Power Pack shall have a molded plastic enclosure with a ½" molded electrical nipple and mounting bracket.

2. Plenum Rated: Each Power Pack shall have a molded plastic enclosure with a 5VA flammability rating suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. Listing: Lighting controls shall be UL/CUL listed and be compliant with the following:

a. FCC Part 15

b. BAA and BABA

c. Title 24, ASHRAE, IECC

4. Controller Power Supply: Each Power Pack shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC (50 to 60 Hz).

5. High Voltage Connections: Each Power Pack shall be provided with 6" wire leads for terminating the high voltage connections.

6. Low Voltage Connections: Each Power Pack shall be provided with x2 RJ45 connectors for connecting devices with CAT5/5e/6 cable and have x3 20 AWG wire leads as an alternate connection method for occupancy sensors.

7. Configuration Options**:** Each Power Pack shall have selectable configuration options to adjust the operation of the power pack.

B. **Switch:** The Switches shall be available in 1 or 2 zone, dimming or non-dimming configurations with 6 color options; White, Ivory, Light Almond, Gray, Black, and Red. Each switch shall have an associated pilot light.

1. **Listing:** Lighting controls shall be UL/CUL listed and be compliant with the following:
   - **a.** FCC Part 15
   - **b.** BAA and BABA
   - **c.** Title 24, ASHRAE, IECC
2. **Low Voltage** Connections: Each switch shall be provided with x2 RJ45 connectors for connecting to other devices with CAT5/5e/6 cable
3. Power: Powered from Power Pack via CAT5/5e/6 cable.
4. Button Labelling: Each Switch shall have field replaceable faceplates with color change kits and the option for individually replaceable buttons that can be custom engraved. It shall also be field reconfigurable to change between different switch types.

C. **Wall Sensor Switch:** The Sensor Switches shall provide dual-tech occupancy sensing via passive infrared (PIR) and overlapping passive acoustic sensing, and be available in 1 or 2 zone, dimming or non-dimming configurations with 6 color options; White, Ivory, Light Almond, Gray, Black, and Red. Each switch shall have an associated pilot light.

1. **Listing:** Lighting controls shall be UL/CUL listed and be compliant with the following:
   - **a.** FCC Part 15
   - **b.** BAA and BABA
   - **c.** Title 24, ASHRAE, IECC
2. **Low Voltage Connections:** Each Sensor Switch shall be provided with x2 RJ45 connectors for connecting to other devices with CAT5/5e/6 cable.
3. **Power:** Powered from Power Pack via CAT5/5e/6 cable.
4. **Button** Labelling**:** Each Sensor Switch shall have field replaceable faceplates with color change kits and the option for individually replaceable buttons that can be custom engraved. It shall also be field reconfigurable to change between switch types.
5. **Sensor Functionality and Adjustments:** The Sensor Switch shall support occupancy and vacancy modes and require an initial PIR event to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut off after 5 minutes of acoustic detection only. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights. Automatic Threshold Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises. Additionally, the sensor switch shall allow for the following manual adjustments:
   - **a.** Sensitivity adjustments for passive infrared and acoustic which can be independently adjusted to three different levels, including PIR-only mode
   - **b.** Vacancy time-delay adjustments
   - **c.** Enable/Disable LED indicators.

D. **Ceiling Sensor:** The Ceiling Sensor shall provide dual-tech occupancy sensing via passive infrared (PIR) and overlapping passive acoustic sensing and include a full range photosensor to support open loop daylight harvesting.

1. **Listing:** Lighting controls shall be UL/CUL listed and be compliant with the following:
   - **a.** FCC Part 15
   - **b.** BAA and BABA
   - **c.** Title 24, ASHRAE, IECC
2. **Low Voltage Connections:** Each Ceiling Sensor shall be provided with x2 RJ45 connectors for connecting to other devices with CAT5/5e/6 cable. Additionally, each Ceiling Sensor shall have the following:
   - **a.** x3 22 AWG wire leads as an alternate connection method to Power Packs or

other 24VDC power supplies.

b. x3 22 AWG wire leads to provide N.O./N.C. auxiliary contacts for connection to HVAC or BAS systems.

c. x2 22 AWG wire leads for direct 0-10VDC control of fixtures by the full range photosensor.

3. Power: Powered from Power Pack via CAT5/5e/6 cable or via x3 22 AWG wire leads as an alternate connection method.

4. Sensor Functionality and Adjustments: The Ceiling Sensor shall support occupancy and vacancy modes and require an initial PIR event to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut off after 5 minutes of acoustic detection only. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights. Automatic Threshold Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises. Additionally, it shall allow for the following manual adjustments:

a. Sensitivity adjustments for passive infrared and acoustic which can be independently adjusted to three different levels, including PIR-only mode

b. Vacancy time-delay adjustments

c. Enable/Disable LED indicators.

d. Photocell 0-10V Scale and Relay cutout adjustments.

2.5 SWITCH STATIONS AND COVER PLATES

A. Hardwired Switches and Cover Plates: Electrical contractor shall provide and install switch plates and switches of the quantities and types shown on the drawings and specified herein.

1. Key Switch

a) Key Switch: Key switch shall consist of a single-pole double-throw momentary or maintained switch. They shall be available to allow the key to being removed in the ON position or the OFF position.

b) Cover p**lates:** Plates shall be available in stainless steel.

2. Wet Location **Touch Switch:**

a) Switch: Touch activated switches shall be momentary push-buttons with an IP65 rating.

b) Cover plates: Single-gang plates available in stainless steel with 1-3 buttons per gang.

c) Gasket: Cover plate neoprene gaskets shall be available for weatherproof applications.

d) Status: LED status indicators rings shall be optional for each switch provided.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation: Where shown in the drawings, the contractor shall furnish and install programmable lighting controllers of the quantities, sizes, and types shown on the drawings or specified herein.

B. Requirements**:** All equipment shall be installed in accordance with manufacturer requirements and in compliance with all applicable local and national codes and requirements.

3.2 MANUFACTURES **SERVICES**

A. Factory Programming: All controllers shall be factory programmed upon request in accordance with the project specifications prior to shipment.

B. Installation Assistance: During the installation process, the manufacturer shall provide, at no cost, technical support via a toll-free telephone line to the installing contractor or owner's representative to answer questions and supply additional information when required.

C. System Start**-Up:** The system manufacturer shall provide a factory authorized field technician to the project site after installation has been completed and prior to the system being energized for the purpose of testing and adjustment of the system. Factory field technician shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 4 weeks prior to scheduling a field technician for the start-up of the system. Should the field technician arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field technician required to complete the system start-up.

D. **On-Site Programming:** During the start-up procedure, the factory field technician shall provide programming assistance and guidance to the building operating personnel to program the systems for initial operation.

E. Instruction: During the start-up procedure, the factory field technician shall provide training to the building operating personnel in the operation, programming, and maintenance of the lighting control system.

F. As-Built Drawings: After completion of the system installation and testing, the manufacturer shall provide 3 sets of "as-built" drawings.

G. Operation and Maintenance Manuals: After completion of the system installation and testing, the manufacturer shall provide 3 sets of Operations and Maintenance Manuals.

H. Lifetime Telephone **Support:** The system manufacturer shall provide a direct telephone number to the system user and shall allow access to free telephone support for the life of the system.

END OF SECTION

SECTION 26 09 22 - ANALOG LIGHTING CONTROL DEVICES

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Line Voltage Sensors Include:
1. Wall Box Occupancy Sensors (Line Voltage)
2. Wall Box Occupancy Sensors with 0-10V Dimming (Line Voltage)
3. Ceiling Occupancy Sensors (Line Voltage)
4. Wide View / Hallway Occupancy Sensors (Line Voltage)
5. Fixture Mount Sensors (Line Voltage)
6. Daylight Sensors (Line Voltage)
7. Wall Box Phase Dimmer (Line Voltage)
8. Wall Box Timer Switch (Line Voltage)
9. Wall Box 0-10V Dimmer (Line Voltage)
10. Wall Box 3-Way Switch (Line Voltage)

B. Low Voltage Sensors, Wall Stations,& Power Packs Include:
1. Power Packs (Load Control Relays)
2. Wall Stations (Low voltage)
3. Wall Box Occupancy Sensors (Low Voltage)
4. Wall Box Occupancy Sensors with 0-10V Dimming (Low Voltage)
5. Ceiling Occupancy Sensors (Low Voltage)
6. Wide View / Hallway Occupancy Sensors (Low Voltage)
7. Daylight Sensors (Low Voltage)

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00 – Administrative Requirements

B. Submittals shall include the following:
1. Bill of Materials: Complete list of parts required to provide a complete and functioning Lighting Control System
2. Manufacturer’s Data Sheets: Data Sheets are to provide information on item function, features, and dimensions
3. Shop and Wiring Drawings:
a. Typical wiring diagrams for all components including, but not limited to, wall box occupancy sensors, ceiling mounted occupancy sensors, daylight sensors, load control relays, and low-voltage wall stations
b. Site Specific Diagrams: Depicting site specific interactions with other systems
c. Installation locations and details for occupancy sensors, daylight sensors, load control relays, and low-voltage wall stations
4. Warranty: Provide copy of applicable device warranty

C. Coordination: Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including luminaires, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.4 WARRANTIES

A. Manufacturer’s Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in material or workmanship within specified warranty period.

B. Failures include any faulty operation of lighting control device(s).

C. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer Qualifications: Manufacturer of Lighting Control System listed in this Section must be comparable to Basis of Design and equal system must meet operational requirements.
1. SENSORWORX (Basis of Design)
2. X
3. X

B. Quality Assurance: All control devices shall be visually inspected by an individual to be free of defects and tested for proper device functionality.

2.2 WALL BOX OCCUPANCY SENSORS (LINE VOLTAGE)

A. Provide wall box occupancy sensor for stand-alone control of lighting load in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Sensor unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Sensor shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
3. Sensor shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Sensor shall have a vandal resistant lens.
5. Sensor shall have a single toggle button to manually control the load
6. Sensor unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.

D. Line Voltage Requirements
1. Sensor unit is rated for 800 Watts @ 120VAC and 1200 Watts @ 277VAC.
2. Sensor unit accommodates both neutral (3-wire) and no neutral (2-wire) installation and shall not require a minimum load. Unit meets NEC 404.2(c) & 404.22 guidelines regarding powering over ground & current leakage.
3. Sensor unit shall have interchangeable line and load wires.
4. Sensor unit shall be available with the ability to control additional line-voltage loads via companion “sidecar” switches located in a common multi-gang wall box. All sidecars shall receive detection signal from the primary sensor unit. Sidecar units can operate with the same or different operational modes, time delays, and detection types as the primary sensor unit.

E. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

F. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

G. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
1. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present

upon initial occupancy).
2. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

H. Sensor unit settings shall be adjustable without removing wall plate cover or unit from wall box.

I. Sensor unit shall have several programable modes of operation:
1. Vacancy Mode
2. Occupancy w/ Predictive (Lock Down) Mode
3. Occupancy w/ Exit Time Mode
4. Override Off Mode
5. Disabled Switch Mode
6. Occupancy Mode (Presentation Operation)
7. Disable Sensor (Toggle Switch Mode)

J. Sensor unit shall have multiple colors of LED indicator light for the following:
1. Detection of occupancy, either passive infrared or acoustic detection
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

K. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

L. Sensor unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

M. Sensor shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

N. Full electronic and mechanical assembly of sensors shall be in the USA.

O. Part Numbers:
1. SWX-100 Series

2.3 WALL BOX OCCUPANCY SENSORS WITH 0-10V DIMMING (LINE VOLTAGE)

A. Provide wall box occupancy sensor for stand-alone control of lighting load in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Sensor unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Sensor shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
3. Sensor shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Sensor shall have a vandal resistant lens.
5. Sensor shall have a toggle, raise, and lower button to manually control the load
6. Sensor unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.
7. Dimming output, 0-10V signal, sinking up to 50 mA

D. Line Voltage Requirements
1. Sensor unit is rated for 800 Watts @ 120VAC and 1200 Watts @ 277VAC.
2. Sensor unit accommodates both neutral (3-wire) and no neutral (2-wire) installation and shall

not require a minimum load. Unit meets NEC 404.2(c) & 404.22 guidelines regarding powering over ground & current leakage.

3. Sensor unit shall have interchangeable line and load wires.

E. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

F. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

G. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
1. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
2. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

H. Sensor unit settings shall be adjustable without removing wall plate cover or unit from wall box.

I. Sensor unit shall have several programable modes of operation:
1. Vacancy Mode
2. Occupancy w/ Predictive (Lock Down) Mode
3. Occupancy w/ Exit Time Mode
4. Override Off Mode
5. Disabled Switch Mode
6. Occupancy Mode (Presentation Operation)
7. Partial On
8. Partial Off

J. Dimming Output feature include:
1. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
2. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
3. Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
4. Sensor shall have selectable Dimming Curves, which define how the dimmer unit adjusts its voltage output in response to button commands:
   a. Linear (default)
   b. Square Log

K. Sensor unit shall have multiple colors of LED indicator light for the following:
1. Detection of occupancy, either passive infrared or acoustic detection
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

L. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

M. Sensor unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

N. Sensor shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

O. Full electronic and mechanical assembly of sensors shall be in the USA.

P. Part Numbers:
1. SWX-100-D Series

2.4 CEILING OCCUPANCY SENSORS (LINE VOLTAGE)

A. Provide a complete and operable occupancy sensor lighting control system in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Sensor housing shall be impact resistant plastic, available in White or Black.
2. Ceiling-Mounted lenses can be swapped in field, if necessary, without need for any tools
3. Sensor unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.
4. Optional Dimming output, 0-10V signal, sinking up to 50 mA

D. Sensors shall be available with the following lens options:
1. 360° field of view for small motion (8 to 12 feet above finished floor, ~500 ft2)
2. 360° field of view for large motion (8 to 15 feet above finished floor, ~2000 ft2)
3. 360° field of view for high bay application (15 to 40 feet above finished floor)

E. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

F. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

G. Optional dimming capabilities via 0-10V Dimming adds the following:
1. Daylight Harvesting to Off
2. Daylight Harvesting to Low trim
3. Partial Off (High/Low)
4. Partial Off plus Delay Off (High/Low/Off)

H. Dimming Output feature include:
1. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
2. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
3. Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

I. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
1. Daylight Harvesting (0-10V Dimming to maintain the target light level). Daylight Harvesting restricts the manual dimming range by a wall dimmer station to a maximum level that equals the setpoint down to the low-trim and/or off position. Sensor will ignore any attempt to raise the lighting above the setpoint with any wall dimmer station.
2. ON/OFF Photocell Control (Lights switched OFF if ambient level surpasses the threshold and back ON if level drops).
3. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
4. Auto-setpoint method which shall automatically determine setpoint in a given area based on

the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

J. Sensors have been designed to fail to the ON condition for predictable internal failure conditions.

K. Sensor unit shall have multiple colors of LED indicator light for the following:
1. Detection of occupancy, either passive infrared or acoustic detection
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

L. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

M. Sensors shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

N. Sensor shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

O. Full electronic and mechanical assembly of sensors shall be in the USA.

P. Part Numbers:
1. SWX-200-2 Series

2.5 WIDE VIEW / HALLWAY OCCUPANCY SENSORS (LINE VOLTAGE)

A. Provide a complete and operable occupancy sensor lighting control system in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Sensor housing shall be impact resistant plastic, available in White or Black.
2. Sensor unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.
3. Mounting options, include corner, wall, and ceiling. It must not require additional mount brackets.

D. Sensors shall be available with the following lens options:
1. 120° field of view for corner mount application.
2. 45° field of view for hallway application.

E. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

F. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

G. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
1. ON/OFF Photocell Control (Lights switched OFF if ambient level surpasses the threshold and then back ON if level drops).
2. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
3. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

H. Sensors have been designed to fail to the ON condition for predictable internal failure conditions.

I. Sensor unit shall have multiple colors of LED indicator light for the following:
   1. Detection of occupancy, either passive infrared or acoustic detection
   2. Response to programming push button
   3. Indication of function current setting when queried
   4. Error code sequence

J. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

K. Sensors shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

L. Sensor shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

M. Full electronic and mechanical assembly of sensors shall be in the USA.

N. Part Numbers:
   1. SWX-400-2 Series

2.6 Fixture Mount Sensors (Line Voltage)

A. Provide a complete and operable occupancy sensor lighting control system in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
   1. Sensor housing shall be impact resistant plastic, available in White.
   2. The lens provided must be a universal lens for High Bay, Low Bay, and Aisle Way applications.
   3. Sensor unit shall be powered by line voltage, 120VAC, 208VAC (2-Phase) or 277VAC, supplied by utility through a local circuit.
   4. Optional Dimming output, 0-10V signal, sinking up to 50 mA

D. Sensor unit shall contain a passive infrared detector. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection.

E. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

F. Optional dimming capabilities via 0-10V Dimming adds the following:
   1. Daylight Harvesting to Off
   2. Daylight Harvesting to Low trim
   3. Partial Off (High/Low)
   4. Partial Off plus Delay Off (High/Low/Off)
   5. Nightlight Operations

G. Dimming Output feature include:
   1. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
   2. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
   3. Fade On and Fade Off Times;
      a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

H. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
1. Daylight Harvesting (0-10V Dimming to maintain the target light level). Daylight Harvesting restricts the manual dimming range by a wall dimmer station to a maximum level that equals the setpoint down to the low-trim and/or off position. Sensor will ignore any attempt to raise the lighting above the setpoint with any wall dimmer station.
2. ON/OFF Photocell Control (Lights switched OFF if ambient level surpasses the threshold and then back ON if level drops).
3. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
4. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

I. Sensors have been designed to fail to the ON condition for predictable internal failure conditions.

J. Sensor unit shall have multiple colors of LED indicator light for the following:
1. Detection of occupancy
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

K. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

L. Sensors shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

M. Sensor shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

N. Full electronic and mechanical assembly of sensors shall be in the USA.

O. Part Numbers:
1. SWX-500 Series

2.7 DAYLIGHT SENSORS (LINE VOLTAGE)

A. Provide a complete and operable daylight sensor system in areas shown on Drawings.

B. Daylight sensor lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Sensors shall be self-contained, photo-electric detectors which shall provide detection of ambient light level in a given area.
2. Sensor unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.
3. Sensor housing shall be impact resistant plastic.

D. Setpoint: The minimum overall light level that shall be maintained in a space by the sensor is referred to as the Setpoint.

E. Sensor shall have a photocell for closed-loop ambient light sensing with the following functions:
1. ON/OFF Photocell Control (Lights switched OFF if ambient level surpasses the threshold and then back ON if level drops).
2. Auto-setpoint method which shall automatically determine setpoint in a given area based on

the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

F. Dimming Output feature include:
1. Daylight Harvesting (0-10V Dimming to maintain the target light level). Daylight Harvesting restricts the manual dimming range by a wall dimmer station to a maximum level that equals the setpoint down to the low-trim and/or off position. Sensor will ignore any attempt to raise the lighting above the setpoint with any wall dimmer station.
2. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
3. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
4. Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

G. Sensor shall have multiple colors of LED indicator light for the following:
1. Notification of upcoming transition to On or Off
2. Indication of ambient level of lighting being sufficient
3. Response to programming push button
4. Indication of function current setting when queried

H. Sensor shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

I. Sensor shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

J. Full electronic and mechanical assembly of sensors shall be in the USA.

K. Part Numbers:
1. SWX-250-2 Series

2.8 WALL BOX PHASE DIMMER (LINE VOLTAGE)

A. Provide wall box dimmer switch for stand-alone control of lighting load in areas shown on Drawings.

B. Wall box dimmer switch control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Switch unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Switch shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
3. Switch shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Switch unit shall be powered by line voltage, 120VAC, supplied by utility through a local circuit.

D. Line Voltage Requirements
1. Dims LED, CFL, ELV, and Incandescent Lighting Loads
2. No minimum Load Rating. Dimmers that require a minimum load to operate at the low end are not acceptable.
3. Dimmer Switch is rated for 375 Watts @ 120VAC for Reverse Phase Mode and 150 Watts @ 120VAC for Forward Phase Mode. Devices that cannot accommodate both Reverse and Forward Phase Modes are not acceptable.

E. Dimming Output feature include:
1. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
2. Low-End Trim settings, enabling minimum user level of dimmer to be customized.

3. Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

F. Switch unit settings shall be adjustable without removing wall plate cover or unit from wall box.

G. Switch unit shall have multiple colors of LED indicator light for the following:
1. Blue locator LED when lights are off.
2. White LED with variable intensity indicating light level
3. Response to programming push button
4. Indication of function current setting when queried
5. Error code sequence

H. Switch unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

I. Switch shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

J. Full electronic and mechanical assembly of sensors shall be in the USA.

K. Part Numbers:
1. SWX-864-ELV Series

2.9 WALL BOX TIMER SWITCH (LINE VOLTAGE)

A. Provide wall box occupancy sensor for stand-alone control of lighting load in areas shown on Drawings.

B. Wall Box Timer Switch lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Switch shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
2. Switch shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
3. Switch shall have a single toggle button to manually control the load
4. Switch unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.

D. Line Voltage Requirements
1. Switch unit is rated for 800 Watts @ 120VAC and 1200 Watts @ 277VAC.
2. Switch unit accommodates both neutral (3-wire) and no neutral (2-wire) installation and shall not require a minimum load. Unit meets NEC 404.2(c) & 404.22 guidelines regarding powering over ground & current leakage.

E. Switch shall be available with adjustable time delay increment settings from 5-to-60 minutes or 1-to-12 hours.

F. Switch unit settings shall be adjustable without removing wall plate cover or unit from wall box.

G. Switch unit shall have multiple colors of LED indicator light for the following:
1. The remaining time indicator.
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

H. The timer switch shall have the option to blink warn the lights before turning on.

I. Sensor unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

J. Sensor shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

K. Full electronic and mechanical assembly of sensors shall be in the USA.

L. Part Numbers:
1. SWX-843 Series

2.10 WALL BOX 0-10V DIMMER (LINE VOLTAGE)

A. Provide wall box dimmer switch for stand-alone control of lighting load in areas shown on Drawings.

B. Wall box dimmer switch control shall include, but not be limited to, all required devices, low and line-voltage wiring.

C. Physical Requirements:
1. Switch unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Switch shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
3. Switch shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Switch unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.
5. Dimming output, 0-10V signal, sinking up to 50 mA

D. Line Voltage Requirements
1. Switch unit is rated for 800 Watts @ 120VAC and 1200 Watts @ 277VAC.
2. Switch unit accommodates both neutral (3-wire) and no neutral (2-wire) installation and shall not require a minimum load. Unit meets NEC 404.2(c) & 404.22 guidelines regarding powering over ground & current leakage.
3. Wall box dimmer shall be capable of being wired in 3-Way configuration with a 3-Way Switch.

E. Dimming Output feature include:
1. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
2. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
3. Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
4. Dimming Curve Type; Linear or Square Log

F. Switch unit settings shall be adjustable without removing wall plate cover or unit from wall box.

G. Switch unit shall have multiple colors of LED indicator light for the following:
1. Blue locator LED when lights are off.
2. White LED scale with indicating light level
3. Response to programming push button
4. Indication of function current setting when queried
5. Error code sequence

H. Switch unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

I. Switch shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

J. Full electronic and mechanical assembly of sensors shall be in the USA.

K. Part Numbers:
1. SWX-823 Series

2.11 WALL BOX 3-WAY SWITCH (LINE VOLTAGE)

A. Provide wall box switch for stand-alone control of lighting load in areas shown on Drawings.

B. Wall box switch control shall include, but not be limited to, all required devices, low and line-voltage wiring.

C. Wall box switch shall be capable of being wired in a 2-Way or 3-Way configuration.

D. Physical Requirements:
1. Switch unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Switch shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
3. Switch shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Switch unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.

E. Line Voltage Requirements
1. Switch unit is rated for 800 Watts @ 120VAC and 1200 Watts @ 277VAC.
2. Switch unit accommodates both neutral (3-wire) and no neutral (2-wire) installation and shall not require a minimum load. Unit meets NEC 404.2(c) & 404.22 guidelines regarding powering over ground & current leakage.

F. Switch unit settings shall be adjustable without removing wall plate cover or unit from wall box.

G. Switch unit shall have multiple colors of LED indicator light for the following:
1. Blue locator LED when lights are off.
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

H. Switch unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

I. Switch shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

J. Full electronic and mechanical assembly of sensors shall be in the USA.

K. Part Numbers:
1. SWX-821 Series

2.12 POWER PACKS (LOAD CONTROL RELAYS)

A. Provide a complete and operable load control relay system to be used in conjunction with low voltage occupancy sensors, daylight sensors, and wall stations in areas shown on Drawings.

B. Power Packs shall include, but not be limited to, all required sensors, wall stations, power supplies, low-voltage, and line-voltage wiring.

C. Physical Requirements:
1. Power Packs shall have an operating voltage of 120VAC or 277VAC.
2. Power Packs housing shall be impact-resistant, and plenum rated plastic.
3. Power Packs shall have an on-board button for programming and testing, which toggles the

load for test purposes.
4. Power Packs shall have snaps integrated into the chase nipple to enable quick mounting to a junction box via a standard knockout.
5. Power Packs shall have an optional snap-on low voltage wiring chamber for concealing low voltage wire connections.

D. Power Packs shall have a Class 2 18VDC power supply. Output Rating of at least 18VDC @ 150mA with 80mA dedicated to powering connected devices. Voltage will be higher when a reduced low voltage load is connected.

E. Power Pack switching relay shall be rated to switch the following loads:
1. 20A @ 120VAC – General Purpose Plug Load
2. 20A @120/277 VAC – General Purpose, Tungsten, Magnetic Ballast
3. 16A @ 120/277 VAC – Electronic Ballast, LED Driver

F. Power Packs shall integrate electronically timed switching (i.e. zero crossing) to ensures long relay life.

G. Power Packs shall have multiple colors of LED indicator light for the following:
1. Indication of normal or other-than-normal operation
2. Response to programming push button
3. Indication of programming function current setting when queried
4. Indication of successful or unsuccessful push button programming

H. Power Packs shall have the following operational modes:
1. Occupancy Mode (Auto On / Auto Off) – (default)
2. Vacancy Mode (Manual On / Auto Off) – requires Low Voltage Wall Station(s)
3. Partial On – requires 0-10V dimming
4. Partial Off – requires 0-10V dimming

I. Optional Features:
1. Power Packs may include 0-10 Volt Stepped Dimming for Partial Off or Partial On Operation.
2. Power Packs may include Auxiliary Switch Input wires for Manual On, Hold On, or Hold Off Operation. It shall include a relay status output signal to keep all connected wall station indicator LEDs operating in unison.

J. Power Packs shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

K. Power Packs shall be UL Listed, Plenum Rated (UL2043), RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

L. Full electronic and mechanical assembly of load control relay shall be in the USA.

M. Part Numbers:
1. SWX-900 Series

2.13 WALL STATIONS (LOW VOLTAGE)

A. Provide low voltage wall stations as required in areas shown on Drawings. These devices are to function seamlessly with other control devices.

B. Low Voltage Wall Station shall include, but not be limited to, all required sensors, relays, power supplies, and low-voltage wiring.

C. Physical Requirements:
1. Wall Station unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Wall Station unit shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.

3. Wall Station unit shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Wall Station unit shall be powered by low voltage, 12-24VDC, supplied by power supply or power pack.

D. Station shall be capable of switching and/or dimming the lighting load with a momentary pulse length of 250msec.

E. Station shall have multiple colors of LED indicator light for the following:
1. Location of switch when lighting load is Off
2. Relay status
3. Response to programming push button
4. Indication of function current setting when queried
5. Current dimming level with five (5) stacked LEDs displayed to the user (3-button dimming station only)

F. Dimming Station:
1. Station shall have High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
2. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
3. Station shall have Turn On/Turn Off Dimming Operation (when used with a load controller and an occupancy sensor):
4. Allow Turns On lighting to last user level or can be programmed to a pre-set level (100%, 50%, or custom).
5. Lighting can also be held at low-end trim level during unoccupied/off state.
6. Lighting can turn Off lighting by switching Off power (by opening relay) or dimming below electronic Off Level.
7. Station shall have adjustable Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
8. Station shall have selectable Dimming Curves, which define how the dimmer unit adjusts its voltage output in response to button commands:
   a. Linear (default)
   b. Square Log

G. Station shall be capable of Multiway Switching with all connected stations indicating the same state. Manual dimming control shall be available at one (1) location.

H. Station shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

I. Station shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

J. Full electronic and mechanical assembly of sensors shall be in the USA.

K. Part Numbers
1. SWX-801, SWX-803, SWX-804

2.14 WALL BOX OCCUPANCY SENSORS (LOW VOLTAGE)

A. Provide wall box occupancy sensor for stand-alone control of lighting load in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required sensors, wall stations, power supplies, low-voltage, and line-voltage wiring.

C. Physical Requirements:

1. Sensor unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Sensor shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
3. Sensor shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Sensor shall have a vandal resistant lens.
5. Sensor shall have a single toggle button to manually control the load output
6. Sensor unit shall be powered by low voltage, 12-24VDC, supplied by power supply or power pack.

D. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

E. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

F. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
1. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
2. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

G. Sensor unit settings shall be adjustable without removing wall plate cover or unit from wall box.

H. Sensor unit shall enable several programable modes of operation:
1. Vacancy Mode
2. Occupancy w/ Predictive (Lock Down) Mode
3. Occupancy w/ Exit Time Mode
4. Override Off Mode
5. Occupancy Mode (Presentation Operation)
6. Disabled Switch Mode

I. Sensor unit shall have multiple colors of LED indicator light for the following:
1. Detection of occupancy, either passive infrared or acoustic detection
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

J. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

K. Sensor unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

L. Sensor shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

M. Full electronic and mechanical assembly of sensors shall be in the USA.

N. Part Numbers:
1. SWX-100-1 Series

2.15 WALL BOX OCCUPANCY SENSORS WITH 0-10V DIMMING (LOW VOLTAGE)

A. Provide wall box occupancy sensor for stand-alone control of lighting load in areas shown on

Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required sensors, wall stations, power supplies, low-voltage, and line-voltage wiring.

C. Physical Requirements:
1. Sensor unit to be self-contained in impact resistant plastic, suitable for mounting in a standard switch box.
2. Sensor shall be less than one (1) inch deep into the switch box in order to provide maximum space for wire connections.
3. Sensor shall have interchangeable face colors that can be field changed without removing the unit from wall box or rewiring. (Available in White, Ivory, Light Almond, Gray, Black, and Red)
4. Sensor shall have a vandal resistant lens.
5. Sensor shall have a toggle, raise, and lower button to manually control the load
6. Sensor unit shall be powered by low voltage, 12-24VDC, supplied by power supply or power pack.
7. Dimming output, 0-10V signal, sinking up to 50 mA

D. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

E. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

F. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
1. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
2. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

G. Sensor unit settings shall be adjustable without removing wall plate cover or unit from wall box.

H. Sensor unit shall enable several programable modes of operation:
1. Vacancy Mode
2. Occupancy w/ Predictive (Lock Down) Mode
3. Occupancy w/ Exit Time Mode
4. Override Off Mode
5. Occupancy Mode (Presentation Operation)
6. Disabled Switch Mode
7. Partial On
8. Partial Off

I. Sensor unit shall have multiple colors of LED indicator light for the following:
1. Detection of occupancy, either passive infrared or acoustic detection
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

J. Dimming Output feature include:
1. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
2. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
3. Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or

15 sec.

4. Sensor shall have selectable Dimming Curves, which define how the dimmer unit adjusts its voltage output in response to button commands:
   a. Linear (default)
   b. Square Log

K. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

L. Sensor unit shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

M. Sensor shall be UL Listed, RoHS Compliant, BA, BAA/TAA and BABA Compliant.

N. Full electronic and mechanical assembly of sensors shall be in the USA.

O. Part Numbers:
   1. SWX-100-1-D Series

2.16 CEILING OCCUPANCY SENSORS (LOW VOLTAGE)

A. Provide a complete and operable occupancy sensor lighting control system in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required sensors, wall stations, power supplies, low-voltage, and line-voltage wiring.

C. Physical Requirements:
   1. Sensor housing shall be impact resistant plastic, available in White or Black.
   2. Ceiling-Mounted (lenses can be swapped in field, if necessary, without need for any tools)
   3. Sensor unit shall be powered by low voltage, 12-24VDC, supplied by power supply or power pack.
   4. Optional Dimming output, 0-10V signal, sinking up to 50 mA for Daylight Harvesting.

D. Sensors shall have the ability to be wired in parallel to provide detection coverage of large areas beyond the range of a single unit. All joined sensors must time out (i.e. register unoccupied) before the lights will turn OFF.

E. Sensors shall be available with the following lens options:
   1. 360° field of view for small motion (8 to 12 feet above finished floor, ~500 ft2)
   2. 360° field of view for large motion (8 to 15 feet above finished floor, ~2000 ft2)
   3. 360° field of view for high bay application (15 to 40 feet above finished floor)

F. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

G. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

H. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
   1. Daylight Harvesting (0-10V Dimming to maintain the target light level). Daylight Harvesting restricts the manual dimming range by a wall dimmer station to a maximum level that equals the setpoint down to the low-trim and/or off position. Sensor will ignore any attempt to raise the lighting above the setpoint with any wall dimmer station.
   2. ON/OFF Photocell Control (Lights switched OFF if ambient level surpasses the threshold and

then back ON if level drops).
3. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
4. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

I. Sensor unit shall enable several programmable modes of operation:
1. Occupancy Mode (Auto On / Auto Off)
2. Vacancy Mode (Manual On / Auto Off)
3. Partial On
4. Partial Off (High/Low)

J. Optional dimming capabilities (-D option) via 0-10V Dimming output adds the following:
1. Daylight Harvesting to Off
2. Daylight Harvesting to Low Trim
3. Partial On
4. Partial Off (High/Low)
5. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
6. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
7. Fade On and Fade Off Times;
   a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
   b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

K. Optional auxiliary contact (-AR option) outputs shall be programmable to:
1. Disabled
2. Relay closed when occupied (state follows white wire). (default)
3. Relay closed when occupied and insufficient ambient light (state follows blue wire). Available for SWX-21x-1-AR and SWX-23x-1-AR models.
4. Relay open when occupied (state opposite white wire)
5. Relay open when occupied and insufficient ambient light (state opposite blue wire). Available for SWX-21x-1-AR and SWX-23x-1-AR models.

L. Sensors have been designed to fail to the ON condition for predictable internal failure conditions.

M. Sensor unit shall have multiple colors of LED indicator light for the following:
1. Detection of occupancy, either passive infrared or acoustic detection
2. Response to programming push button
3. Indication of function current setting when queried
4. Error code sequence

N. A test mode is required to ensure that sensor has proper coverage by allowing the installer to efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

O. Sensors shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

P. Sensor shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

Q. Full electronic and mechanical assembly of sensors shall be in the USA.

R. Part Numbers:
1. SWX-200-1 Series

2.17 WIDE VIEW / HALLWAY OCCUPANCY SENSORS (LOW VOLTAGE)

A. Provide a complete and operable occupancy sensor lighting control system in areas shown on Drawings.

B. Occupancy sensor lighting control shall include, but not be limited to, all required sensors, wall stations, power supplies, low-voltage, and line-voltage wiring.

C. Physical Requirements:
   1. Sensor housing shall be impact resistant plastic, available in White or Black.
   2. Sensor unit shall be powered by low voltage, 12-24VDC, supplied by power supply or power pack.
   3. Mounting options, include corner, wall, and ceiling. It must not require additional mount brackets.

D. Sensors shall have the ability to be wired in parallel to provide detection coverage of large areas beyond the range of a single unit. All joined sensors must time out (i.e. register unoccupied) before the lights will turn OFF.

E. Sensors shall be available with the following lens options:
   1. 120° field of view for corner mount application.
   2. 45° field of view for hallway application.

F. Sensor unit shall contain a passive infrared detector and an optional on-board microphone in dual technology models for passive audio detection. Sensor unit requires a passive infrared detection event to activate lights and will maintain occupied state dependant on continued passive infrared detection or, when dual technology is utilized, acoustic detection of occupants by the microphone.

G. Sensors shall have adjustable time delay increment settings from 30 seconds to 30 minutes (default 10 minutes), that is easily adjustable via push button without the use of dip switches, POTS or dials.

H. Sensor shall have an optional integrated photocell for closed-loop ambient light sensing with the following functions:
   1. ON/OFF Photocell Control (Lights switched OFF if ambient level surpasses the threshold and then back ON if level drops).
   2. Inhibit Only Photocell Control (Lighting is held OFF if sufficient ambient light level is present upon initial occupancy).
   3. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

I. Sensor unit shall enable several programable modes of operation:
   1. Occupancy Mode (Auto On / Auto Off)
   2. Vacancy Mode (Manual On / Auto Off)

J. Optional auxiliary contact (-AR option) outputs shall be programmable to:
   1. Disabled
   2. Relay closed when occupied (state follows white wire). (default)
   3. Relay closed when occupied and insufficient ambient light (state follows blue wire). Available for SWX-41x-1-AR and SWX-43x-1-AR models.
   4. Relay open when occupied (state opposite white wire)
   5. Relay open when occupied and insufficient ambient light (state opposite blue wire). Available for SWX-41x-1-AR and SWX-43x-1-AR models.

K. Sensors have been designed to fail to the ON condition for predictable internal failure conditions.

L. Sensor unit shall have multiple colors of LED indicator light for the following:
   1. Detection of occupancy, either passive infrared or acoustic detection
   2. Response to programming push button
   3. Indication of function current setting when queried
   4. Error code sequence

M. A test mode is required to ensure that sensor has proper coverage by allowing the installer to

efficiently perform a walk test. The sensor will blink white on any detected PIR event and blue on any detected acoustic event, although its time delay will only be reset by a PIR event. While in test mode, the blue locator LED also will not be lit when the lights are off (i.e. relay open).

N. Sensors shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

O. Sensor shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

P. Full electronic and mechanical assembly of sensors shall be in the USA.

Q. Part Numbers:
1. SWX-400-1 Series

2.18 DAYLIGHT SENSORS (LOW VOLTAGE)

A. Provide a complete and operable daylight sensor system in areas shown on Drawings.

B. Daylight sensor lighting control shall include, but not be limited to, all required devices and line-voltage wiring.

C. Physical Requirements:
1. Sensors shall be self-contained, photo-electric detectors which shall provide detection of ambient light level in a given area.
2. Sensor unit shall be powered by line voltage, 120VAC or 277VAC, supplied by utility through a local circuit.
3. Sensor housing shall be impact resistant plastic.

D. Setpoint: The minimum overall light level that shall be maintained in a space by the sensor is referred to as the Setpoint.

E. Sensor shall have a photocell for closed-loop ambient light sensing with the following functions:
1. ON/OFF Photocell Control (Lights switched OFF if ambient level surpasses the threshold and then back ON if level drops).
2. Auto-setpoint method which shall automatically determine setpoint in a given area based on the controlled and uncontrolled light sources or a manual setpoint from 2.5fc to 99fc.

F. Dimming Output feature include:
1. Daylight Harvesting (0-10V Dimming to maintain the target light level). Daylight Harvesting restricts the manual dimming range by a wall dimmer station to a maximum level that equals the setpoint down to the low-trim and/or off position. Sensor will ignore any attempt to raise the lighting above the setpoint with any wall dimmer station.
2. High-End Trim settings, enabling energy saving task tuning by setting a maximum level (100%-50%) to which users are allowed to raise lights.
3. Low-End Trim settings, enabling minimum user level of dimmer to be customized.
4. Fade On and Fade Off Times;
    a. Adjustable time interval for level to ramp up to Turn On Level is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.
    b. Adjustable time interval for level to ramp down to Off is 0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec.

G. Sensor shall have multiple colors of LED indicator light for the following:
1. Notification of upcoming transition to On or Off
2. Indication of ambient level of lighting being sufficient
3. Response to programming push button
4. Indication of function current setting when queried

H. Sensor shall have an operating temperature from 32°F to 122°F (0°C to 50°C) standard, and down to -40°F/C with an optional conformal coating.

I. Sensor shall be UL Listed, RoHS Compliant, and BA, BAA/TAA and BABA Compliant.

J. Full electronic and mechanical assembly of sensors shall be in the USA.

K. Part Numbers:
1. SWX-250-1 Series

PART 3: EXECUTION

3.1 INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other constructions that is supported by and/or penetrates the ceiling, including luminaires, smoke detectors, HVAC equipment, and fire-suppression systems.

B. Install and aim sensors to achieve not less than 90 percent coverage of indicated areas. Do not exceed coverage dimensions as specified by the manufacturer. Allow six (6) feet of cable slack for sensor location adjustment.

3.2 IDENTIFICATION

A. Identification: Refer to Section 26 05 53, “Identification of Electrical Systems”, for specific identification requirements, including, but not limited to, identification of circuits and luminaires, labelling, nameplates, and applicable painting.

3.3 WIRING

A. Wiring Method: Comply with Section 26 05 19 “Low-Voltage Electrical Power Conductors and Cables”.

B. Size conductors according to lighting control device manufacturer’s written instructions, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field Testing: Perform the following field tests and inspections and prepare test reports:

B. After installing all sensors, load controllers, and wall stations, and after electrical circuity has been energized, adjust and test for compliance with requirements.

C. Operational Test: Verify operation of each lighting control device and confirm the time delay duration.

D. Demonstration: Upon completion of testing and adjustment, the Contractor shall demonstrate operation of the system to representatives of the Owner and Engineer.

E. Training: The Contractors shall instruct the Owner's personnel in proper maintenance, adjustment, and operation of the occupancy sensor lighting controls.

END OF SECTION 26 09 23

SECTION 26 09 23 - LIGHTING CONTROL SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. The intent of this set of specifications is to provide a complete, functional, intelligent, low-voltage lighting control system for the control of incandescent, low-voltage, LED, neon, cold cathode, fluorescent and HID lighting sources.

B. Where shown in the drawings, the contractor shall furnish and install a complete low-voltage lighting control system consisting of, but not limited to, relays, contactors, controllers, enclosures, switch stations, and miscellaneous components as required for a complete, operational lighting control system.

C. Where applicable standards have been established, all items of equipment, individual components, and installation methods shall meet the requirements of these standards, including, but not limited to, Underwriter Laboratories, the National Electrical Code, Federal Communications Commission, and any local or state codes that may be applicable.

D. The products specified herein are based on those of Intelligent Lighting Controls, Inc. Low voltage lighting control systems manufactured by the following manufacturers shall be considered providing they meet the requirements of these specifications and provide the quality and performance specified herein.
1. Intelligent Lighting Controls, Inc.
2. Cooper Controls LKT
3. Leviton Greenmax

E. Listing a manufacturer as acceptable does not in any way relieve the contractor from the responsibility for providing a lighting control system that meets all the requirements of these specifications.

F. All manufacturers shall submit to the specifying engineer a line-by-line compliance comparison between each specification requirement and the system being proposed.

G. Any ambiguities in the drawing or specification shall be brought to the attention of the specifying engineer for clarification.

1.2 QUALITY ASSURANCE

A. **Factory Assembly:** All relays, contactors, controllers, enclosures, switch stations and miscellaneous components shall be factory assembled and tested. All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and low-voltage control stations and/or network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.

B. **Manufacturer:** A minimum of 30 years of experience in the design and manufacture of lighting control equipment.

C. **Component Testing:** All system components and assemblies shall be individually tested before assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications before shipment.

D. **NEC Compliance:** All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.

E. **NEMA Compliance:** All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. **UL/CUL Approval:** All applicable equipment shall be UL/CUL listed under section 916 and shall bear labels indicating compliance.

G. **FCC Emissions:** All applicable equipment shall comply with FCC emissions standards specified in Part 15 and Part 68 where applicable, for commercial applications and shall bear labels indicating compliance testing. Equipment that does not meet these standards shall not be acceptable.

H. **Made in USA:** All products shall be made in the USA. Products manufactured other than in the USA are unacceptable.

1.3 SUBMITTALS

A. The manufacturer shall provide an electronic copy of submittal drawings and data for approval before beginning the manufacture of equipment.

B. Hard copy submittal package shall be provided upon request.

C. Submittal package shall include, but not be limited to, the following. Submittals that do not contain all the information listed below will not be considered for approval.

1. **Specifications Compliance:** Submit a line-by-line comparison that describes the differences between each specification requirement and the equipment/systems being proposed. The comparison shall include a complete listing of how the proposed equipment/systems differ from those specified in size, quantity, quality, method of control, features and functions, control software functions, and installation requirements.
2. **System Description:** Supply as part of the submittal package a brief description of the lighting control system's major features and functions.
3. **Bill of Materials:** Provide as part of the submittal package a detailed itemized listing of all proposed equipment, including quantities and capacities for all major system components.
4. **Product Data Sheets:** Provide as part of the submittal package detailed product data sheets for all major system components.
5. **Riser Drawing:** Provide as part of the submittal package a system riser drawing of sufficient detail to indicate the relative placement of major system components and the required connections between each. Drawings shall be project specific. Generic or typical riser diagrams shall not be acceptable.
6. **Control Schedules:** Provide as part of the submittal package a complete control schedule spreadsheet for relay panels, Timers, Inputs, Groups, and Presets.
7. **Switch Details:** Provide as part of the submittal package complete switch details including color, gangs, buttons, plate style, plate colors, and engraving.
8. **Warranty:** Provide as part of the submittal package a complete written warranty.

1.4 WARRANTY

A. **Manufacturer's Warranty:** The manufacturer shall provide a written warranty that shall cover all lighting control equipment. The manufacturer shall agree to repair or replace any equipment that fails due to material or workmanship for a period of 6 years.

B. **Relay Warranty:** The manufacturer shall provide a separate written warranty that shall cover all lighting control relays within the lighting control system. The manufacturer shall agree to replace any relay that fails due to material or workmanship for a period of 6 years.

C. **Warranty Period:** The warranty period shall begin after the completion of the installation and the systems field start-up and training. Systems not provided with a field start-up begin upon receiving the product.

PART 2 PRODUCTS

2.1 PROGRAMMABLE LIGHTING CONTROL PANELS

A. **Hardware Features:**
1. **Controller Back-Box:** Each programmable lighting controller shall be provided with a factory furnished; UL listed NEMA 1 enclosure designed for wall mounting. The backbox must be capable of being shipped ahead of the controller chassis insert to allow for rough-in of all electrical connections prior to receipt of the controller chassis insert.
2. **Controller Chassis Insert:** Each programmable lighting controller shall be provided with a factory or field-installable controller chassis insert. The Controller chassis insert shall contain all controller electronics, power supplies, relays, contactors, and other required components. Controller chassis inserts shall arrive at the project site completely pre-wired and require only the connection of lighting circuits and control devices.
3. **Line Voltage / Control Voltage Separation:** Each programmable lighting controller shall be provided with a mechanical barrier that separates all line voltage components and wiring from all control voltage components and wiring. An additional barrier may be installed within the line voltage section that shall provide isolation between normal and emergency circuits where required.
4. **Controller Covers:** Each programmable lighting controller shall be provided with a dead front screw-held or hinged locking cover that is designed for either surface or flush mounting. Flush mount doors shall be provided with a trim ring. If a hinge-locking door is provided, it shall be provided with a slam-latch with 2 keys and door hooks to assist in mounting.
5. **Controller Capacity/Configurations:** Controllers shall be available in sizes to accommodate 4, 8, 16, 24, 32, 40, 48, 56, and 64 relay outputs. Controllers shall be available with the electronics in the center and voltage dividers with the lighting relays on the right and left sides.

B. **Electrical:**
1. **Controller Power Supply:** Each programmable lighting controller shall be provided with a dual-rated, UL-listed Class 2 transformer capable of either 120/277 VAC or 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.
2. **Connections:** All connections shall be made to clearly and permanently labeled termination points.

C. **Controller Electronics:**
1. **Controller CPU:** Each programmable controller shall be provided with a CPU (Central Processing Unit) that shall provide all the programming and control functions for the entire controller.
2. **Real-Time Clock:** Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.
3. **Relay Driver Module:** Relay output cards shall be provided to expand the controller capability from 8 to 64 relay outputs in increments of 8. Electronics shall feature surge

protection and optic isolation. It shall also provide an interface for mounting input boards.

4. **Relay Control Switches:** Controller shall contain push-button switches to turn all relays ON or OFF without the presence of any programming.
5. **Backup and Restore:** The controller shall be equipped with an internal memory backup and restore capability. It shall have the ability to back up all internal programming into additional onboard memory, verify present programming with backup, and restore programming.
6. **Runtime Logging:** The controller shall be equipped with memory to log the runtime of each relay. It shall be capable of storing up to 30 days or 1092 hours of data and be able to be exported in a delimitative format.
7. **Non-Volatile Memory:** Controller shall contain a minimum of 4 Mb of nonvolatile EEPROM memory with data retention of >200 years and electrostatic discharge protection of >4000V.
8. **Power Input Surge Suppression:** The controller's 24VAC power input shall be equipped with double surge suppression to protect the electronics from transient over-voltages. Protection shall clamp over-voltages up to 123 volts.
9. **Data Line Surge Suppression:** The controller data line communications shall be equipped with transient voltage suppression protection that will protect the electronics from electrostatic discharge and other transient over-voltages. Protection shall clamp transients up to 8kv direct discharges and 15kv air discharges.
10. **Data Line Communications:** The controller shall be equipped with serial communications through RJ45 connectors for communicating on CAT-5 cable with other panels and devices. It shall also be equipped with a separate local port for communicating with devices. The communications shall consist of 2-RS485 data lines.
11. **USB Serial Communications:** A USB port shall be provided for programming and interfacing the system with the use of a personal computer.
12. **TCP/IP Communications:** A TCP/IP port shall be provided for programming and interfacing the system with a personal computer over a network (LAN) or the internet (WAN).
13. **Optional Module Interface:** The controller shall contain 4 ports for interfacing optional modules which include communications and power. Optional modules shall be able to be mixed on each controller.

D. **Switching and Control Devices:**

1. **Device Node Capacity:** The lighting controller shall support switch input control of up to 64 data line devices locally per panel and 254 per network for up to 16,510 devices. The first 8 device nodes shall be powered by the lighting controller. The addition of a power supply or power supply/repeater shall be required for each additional 20-device node. Each device shall have a unique address and shall be capable of being programmed to the applicable functions described in the Switched Input Types heading in this specification.
2. **Data Line Media:** The data line shall consist of RS485 communications protocol transmitted over CAT-5, CAT-5E, or CAT-6 Cable. The cable shall have male RJ45 connectors installed on each end for interfacing controllers and devices. Both daisy-chain and "T" (3-direction branching) of cable runs shall be permitted. "T" branching shall be accomplished by the addition of power supply/repeaters. It shall be able to be wired in a home-run configuration for devices by the addition of a Hub.
3. **Switch Stations:** Data line switch stations shall be available in momentary push button (1-7 switches and pilots) and each switch shall have an associated pilot light. It shall be provided with optional dimming Raise and Lower buttons. Switches can be provided as Scene Multi-zone, Scene Stations, Multi-zone Stations, or Non-Dim Stations. Each button shall control any or all the relays in the lighting controllers or the dimmer outputs on the network. There shall be an option to program each pilot LED to indicate the state of any Relay, Group, Preset, Scene, and static ON or OFF. It shall also have the capability to reverse the status: LED is ON if the relay is OFF etc.

It shall be available with an optional Bluetooth interface option for interfacing and programming panels with an app. It shall have an optional 915 MHz radio with point-to-point capabilities. It shall communicate 100 feet of line-of-sight with the wireless devices.

4. **Photocell Controllers:** The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs on the network.
5. **Input Modules:** The input module shall provide 4 inputs that accept momentary, momentary PB, and maintained switch closures. Each input shall be optically isolated and can accept dry contact closures or 12-24VDC signals. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs on the network. It shall provide four pilot outputs that provide the true status of relays, groups, and presets. It shall be installed in the control panel or remotely mounted.
6. **Disable Key Switch:** The disable switch shall provide an RJ45 connector that shall disable all devices down line with the closure of a key switch. It shall also provide two RJ45 connectors to pass data through. It shall indicate with an LED when the disable switch is active.
7. **Occupancy Sensor Input Module:** The occupancy sensor input module shall provide power and inputs for motion sensors. It shall have 4 or 8 independent inputs that shall be able to interface multiple sensors. Each input shall control any or all of the relays in the lighting controllers or the dimmer outputs on the network. It shall have the ability to set AND/OR conditional logic. It shall be installed in the control panel or remotely mounted.
8. **0-10V Dimmer Output Module:** The 0-10VDC dimmer output module shall be designed to control dimmable ballasts or other 0-10VDC devices. Each module shall have 4 independent output channels that can control up to 200 devices per output at .5mA per device. It shall have the capability to vary its level 256 steps between 0 and 10VDC. It shall be able to respond to photo controllers, switch inputs, DMX512 signals, and timers. Each output shall be galvanically isolated up to 1500V to protect electronics. It shall be installed in the control panel or remotely mounted.
9. **Motor Control Output Module:** The motor control output module shall be designed to control shade motors, louver motors, blind motors, skylights, or any other class 2 DC motors. Each module shall have 4 independent outputs that can be controlled by a switch input, photocell, or timer. The control time shall be selectable from .1 to 300 seconds. Each lighting controller shall handle up to 8 modules with 4 outputs on each. Each output shall be equipped with a limit switch input for each direction of the motor.
10. **Graphical Touch Screen Control Station:** The Touch screen control station shall display the status and control the lighting control panel relay outputs via pre-programmed control objects on standard or custom bitmap screens.

E. **Special Purpose Modules:** The following special-purpose controller nodes shall be available. Four modules shall be permitted per controller.

1. **BACnet Control:** This module shall communicate directly to the lighting controller through serial communications from the BAS system using BACnet MSTP or BACnet IP protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.
2. **DMX Control:** This module shall support the control of relays using the standard USITT DMX512 protocol used by theatrical lighting systems. Each relay in the lighting panel shall be configured to be controlled by any DMX channel. It shall contain a frame filter that can be set from 1 – 16 frames. It shall have a priority setting for switch inputs or DMX signals. It shall have the capability to control any 0 – 10V dimming output throughout the network. It shall display current DMX levels from the keypad.

3. **DMX Driver:** This module shall send DMX signals from the lighting control panels using the standard USITT DMX512 protocol used by theatrical lighting systems. Each module added to the panel shall control up to 64 channels. Each dimming output channel shall be able to be mapped to 1-512 DMX channels. It shall be 1 to 1 mapped or programmed with free software. It shall be installed in the control panel or remotely mounted.
4. **Modbus Control:** This module shall communicate directly to the lighting controller through RS485, RS232, or TCP serial communications from the BAS system using Modicon Modbus RTU or ASCII protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.
5. **N2 Control:** This module shall communicate directly to the lighting controller through serial communications from the BAS system using the Metasys-N2 protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.
6. **Protocol Input Control:** This module shall allow serial communications from a Modbus, N2, or BACnet network. It shall be capable of emulating LightSync switches or photocells for direct control and status of relays, dimmers, or motor controls.

F. **Programming:** Programmable controllers shall be capable of being programmed, monitored, backed up, or controlled through any of the below methods. All programming changes shall take effect immediately as they are programmed and shall not suspend or disable switches or other system functions. The same functions shall be available for any of the connection types.
1. **Local Keypad and Display:** The system user shall be able to program, monitor, and control any of the controller features and functions through the use of a simple menu-driven self-prompting user interface consisting of a 4-line 20-character backlit LCD display and 8 selection keys that change function based on the current operating mode.
2. **USB Serial Direct Connect:** The system user shall be able to program, monitor, or control any of the controller features and functions utilizing Pro Windows-based graphical user interface software using a USB port from a PC.
3. **TCP/IP Connect:** The system user shall be able to remotely program, monitor, or control any of the controller features and functions utilizing Pro Windows-based graphical user interface software using a PC with TCP/IP on a LAN or WAN.

G. **Diagnostics:** Programmable controllers shall have the ability to do the following diagnostics.
1. **Power Status:** Each programmable lighting controller shall be provided with an LED on the controller and each output board shall indicate that power is present.
2. **Keypad:** System users shall be able to view thru the keypad the status of any relay, input, group, or preset and force any ON or OFF.
3. **Software:** System users shall be able to view thru the Pro software the status of any relay, input, group, or preset and force any ON or OFF. It shall also be able to scan the network for devices and controllers and then poll them to verify network quality.
4. **Relay Cycle Test:** The controller shall have a cycle test for relays to turn them off/on/off and then return them to the original state to verify proper operation. It shall display the results for each relay for turning the relay ON and OFF.
5. **Device Finder:** It shall have the capability through the keypad to find devices, dimmer devices, and motor devices on the network.
6. **Switch Test Mode:** It shall be able to enter a switch test mode, where a switch input status LED will light when switch inputs are activated. It shall disable normal control when in this mode.
7. **Demo Clock:** It shall have the ability to speed the clock’s time by 10, 30, or 60 times for testing timer functions.

H. **Power Failure and Power-Up:** Each programmable lighting controller shall be provided with circuitry that shall automatically shut down the controller whenever the incoming power fails to be delivered to the controller within the required limits. When power is returned to the controller, one of the following power-up modes will be implemented for each controlled relay output in the system.
   1. **No Action:** Upon restoration of incoming control power, the controller electronics shall be restarted and resume normal operations and all circuits will be maintained in the condition they were last in.
   2. **Turn ON:** Controller shall turn the selected relay output to the ON state after power-up.
   3. **Turn ON if Input Closed:** Controller shall turn the selected relay output to the ON state after power-up if the local input selected is closed. It shall be able to select any input to monitor.
   4. **Turn OFF:** Controller shall turn the selected relay output to the OFF state after power-up.
   5. **Turn OFF if Input Closed:** Controller shall turn the selected relay output to the OFF state after power-up if the local input selected is closed. It shall be able to select any input to monitor.
   6. **On if Open Time, OFF if Closed Time:** Controller shall turn the selected relay output to the ON state during Open hours and shall turn selected relay outputs to the OFF state during Closed hours. This shall be used in conjunction with OPEN/CLOSED timers.
   7. **OFF if Open Time, ON if Closed Time:** Controller shall turn the selected relay output to the OFF state during Open hours and shall turn selected relay outputs to the ON state during Closed hours. This shall be used in conjunction with OPEN/CLOSED timers.
   8. **Time of Day:** Controller shall turn the selected relay output to the ON or OFF state based on the time of day in 30-minute increments for every day of the week.

I. **True Relay Status Feedback:** Each controller shall be provided with circuitry that shall monitor the actual status of each relay via a set of pilot contacts mechanically linked to the relay main contacts.

J. **Switch Input Details:** All switch inputs shall have the following options:
   1. **Input Flexibility:** Each switch input shall accept a 2 or 3-wire maintained or momentary switch. It shall be capable of accepting a dry contact, open collector closure, or a 12-24VDC signal. Each switch shall be able to have 2 switch types associated with it in an A/B form.
   2. **Input to Output Programmability:** Any switch input shall be programmed to control any or all the controller's relay outputs without limitations in the network.
   3. **Input Logic Conditionals:** All switch inputs shall have 2 conditionals that add a logic "AND" or "OR" dependent on a relay on, a relay off, an "on" input opened or closed, and an "off" input opened or closed. It shall also have a priority level setting.
   4. **Input Active Times:** All switch inputs shall have a time-of-day or open/close time of action. This shall change the switch type on the time of day every 30 minutes or change per open/closed times.
   5. **Input Types:**
      a) **Momentary ON/OFF:** When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON. When momentary contact is made between OFF and COM, relay outputs controlled by this input shall be turned OFF.
      b) **Momentary ON/OFF w/Blink:** When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON. When momentary contact is made between OFF and COM, relay outputs controlled by this input shall blink and postpone being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each

relay twice prior to turning it OFF. If an ON command is received during the blink alert time, relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.

c) **Momentary Push-Button ON/OFF:** When momentary contact is made between the ON and COM, relay outputs controlled by this input are turned ON and OFF alternately, based on the current state, each time contact is made.

d) **Momentary Push-Button ON:** When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON.

e) **Momentary Push-Button OFF:** When momentary contact is made between ON and COM, relay outputs controlled by this input shall be turned OFF.

f) **Momentary Push-Button Toggle:** When momentary contact is made between ON and COM, relay outputs controlled by this input shall toggle from the present state.

g) **Maintained ON/OFF:** When contact is made between the ON and COM, relay outputs controlled by this input are turned ON. When contact is broken between ON and COM, relay outputs controlled by this input are turned OFF.

h) **Maintained Multi-way:** When contact is either made or broken between the ON and COM, relay outputs controlled by this input will be toggled between ON and OFF conditions. This function shall be similar to that of standard 3 and 4-way switches.

i) **Maintained ON/OFF w/Blink:** When contact is made between the ON and COM, relay outputs controlled by this input are turned ON. When contact is broken between ON and COM, relay outputs controlled by this input shall blink and postpone being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning OFF. If an ON command is received during the blink alert time, relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.

j) **Timed ON:** The timed-ON input shall operate either from the input closure or open. If programmed to operate from the closure, the relays turn ON when the input closes and turn OFF after the time duration. The relays do nothing when the input opens. If programmed to operate from the open, the relays turn ON when the input closes and remain ON. When the input opens, the relays turn OFF after the timed-ON duration.

k) **HID Bi-Level:** This feature requires the configuration of ON/OFF relay outputs and HI/LOW relay outputs. The first momentary contact between ON and COM sets the ON relay outputs to ON and the HI/LOW outputs to HI (for at least 15 Minutes). The second contact switches the HI/LOW outputs to LOW. Additional contact closures will toggle the HI/LOW relay outputs. The cycle then repeats until momentary contact is made between the switch input OFF and COM. then the ON/OFF outputs and HI/LOW outputs are turned OFF.

l) **Two-Step Alternating Sequence:** The first time the switch is activated, relay outputs programmed as “Group A” are turned ON, and relay outputs programmed as “Group B” are turned OFF. The second time the switch is activated, “Group A” relay outputs are turned OFF, and “Group B” relay outputs are turned ON. The third time the switch is activated, the pattern begins again at step one.

m) **Four-Step Alternating Sequence:** The first time the switch is activated, relay outputs programmed as “Group A” are turned ON, and relay outputs programmed as “Group B” are turned OFF. The second time the switch is activated, “Group A” relay outputs are turned OFF, and “Group B” relay outputs are turned ON. The third time the switch is activated; both “Group A” and “Group B” relay outputs are turned ON. The fourth time the switch is activated; both “Group A” and “Group B” relays are turned OFF. The fifth time the switch is activated, the process begins again at step one.

n) **Set Preset:** When momentary contact is made between the ON and COM, the selected preset scene will be activated.
o) **Set Scene:** When momentary contact is made between the ON and COM, the selected scene will be activated.
p) **Force Timer:** When momentary contact is made between the ON and COM, the selected timer will be activated.

K. **Timer Functions:** Each of the programmable lighting controllers shall have the described timer options listed below for the relay outputs.
1. **Time-of-Day Timers:** Each programmable lighting controller shall be provided with a minimum of 128 available timers (scheduled events) for use in developing time-of-day automated schedules. Each timer shall have the ability to turn any or all relay outputs ON or OFF at any time in 1-minute increments. Timers shall be day-of-week selectable and may be programmed to activate on any combination of days of the week. Each shall be capable of being programmed to be enabled or disabled for any day of the calendar year.
2. **Astronomical Scheduling:** Each controller shall contain an astronomical time clock that shall calculate sunrise and sunset times based on the geographical latitude and longitude positioning. Sunrise and sunset times may be used as activation times for any system timer. In addition to sunrise and sunset time activation, the control shall be capable of programming activation time before and after these times based on an offset of 1-999 minutes.
3. **Open/Closed Time Control:** The user shall also have the option of controlling relay outputs in relation to the Open/Closed times of the facility. The Open/Closed times may vary for different days of the week and may be programmed for each day of the year. In addition to Open/Closed time activation, the control shall be capable of programming activation time before and after these Open/Closed times based on an offset of 1-999.
4. **Off-Hour Sweeps:** The system shall also support after-hours OFF sweeps of selected relays or groups of relays at user-defined one, two, or three-hour intervals.

L. **Relay Output OFF Options:** Each relay shall have the option to control the relay OFF in a certain way other than the default OFF.
1. **Single Blink Alert:** Each relay output within the programmable lighting controller shall be individually programmable to blink and postponed prior to being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning OFF with a timer OFF sweep to warn occupants of the upcoming OFF event. If an ON command is received during the blink alert time, the relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.
2. **Double Blink Alert:** Each relay output within the programmable lighting controller shall be individually programmable to blink and postponed prior to being turned OFF and then blinked 1 minute before turning OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice for each alert to warn occupants of the upcoming OFF event. If an ON command is received during the blink alert time, the relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.
3. **HID Delay:** Each relay output within the programmable lighting controller shall have the ability to be controlled like a Single Blink Alert as described above but without the blink, alert to prevent damage to HID lamps.
4. **Alarm ON:** Relays shall be capable of performing a momentary ON function. The ON function shall be programmable from 1 to 99 seconds.
5. **Alarm OFF:** Relays shall be capable of performing a momentary OFF function. The OFF function shall be programmable from 1 to 99 seconds.

6. **Alarm Pulsed ON:** Relays shall be capable of being cycled ON and OFF at 1-second intervals and returning to the OFF state. It shall be programmable from 1 to 90 seconds.
7. **Alarm Pulsed OFF:** Relays shall be capable of being cycled OFF and ON at 1-second intervals and returning to the ON state. It shall be programmable from 1 to 90 seconds.
8. **Automatic Control Switch-OFF:** Relays shall be capable of being cycled OFF for 5 seconds and then returned to the ON state for controlling Sentry or AS110 switches.
9. **Automatic Control Switch-Blink:** Relays shall be capable of being cycled OFF for 1.5 seconds and then returned to the ON state for controlling Delay-OFF mode on AS110 switches.

M. **Presets:** The lighting controller shall support up to 256 user-defined presets of ON/OFF relay patterns. The presets shall be invoked by a switch or timer actuation.

N. **Descriptive Names:** The system shall support the optional assignment of descriptive names (up to 10 characters) to the lighting controller, relay outputs, relay groups, inputs, timers, and presets. These names shall be able to switch from custom names to default names.

O. **Password Protection:** Each Programmable controller shall have user-definable 6-digit alphanumeric passwords with 2 levels of access. It shall have control and edit for level 1 and control-only access for level 2.

P. **Networking:**
1. **Network Capacities:** In addition to the data line devices mentioned in Section D, Controllers shall be linked together on the data line to form a Local Area Network (LAN) of up to 254 controller nodes.
2. **Network Features:** The network manager shall allow the connection of up to 254 controllers and 254 data line devices (on top of the 64 devices per panel) and provide USB communications. It shall have a high-speed scanner, 4 gateway device ports, power for devices, and TCP/IP.
3. **Network Universe:** The network of panels shall be capable to connect to other networks over a network (LAN) or over the internet (WAN) to interconnect multiple systems.
4. **Network Gateway:** The following special-purpose gateways shall be available and provides network-wide control from a single point for its specialized function:
   a) **Modbus Control:** The Modbus gateway shall support communications from the BAS system using Modicon Modbus protocol from a single-point connection. All network input status, relay status, and control shall be supported.
   b) **N2 Control:** The N2 gateway shall support communications from the BAS system using a Metasys-N2 protocol from a single-point connection. Network-wide group status and control shall be supported.
   c) **BACnet Control:** The BACnet gateway shall support communications from the BAS system using BACnet MSTP or BACnet IP protocol from a single point connection. It shall allow up to 500 single relays, 100 multiple relays, 48 groups, and 48 presets.

   d) **Advanced BACnet Control:** The Advanced BACnet gateway shall support communications from the BAS system using BACnet IP protocol from a single-point connection. It shall allow up to per panel; 20 Relays, 20 Dimmers, 16 devices (128 maintained inputs), 64 Groups/Presets, and 48 Scenes.
5. **BAS System / Lighting Control System:** Programmable lighting controllers integrated/interfaced with other building control and alarm systems must remain completely functional and continue to process all programmed commands, including time schedules and local switching.

Q. **Runtime Logging and Trending:** Each lighting control panel shall be capable of logging Runtime and Trending data for each relay. This data shall be able to be harvested and exported from the entire system.

1. **Runtime Logging:** The controller shall be able to internally log the runtime of each relay for up to 30 days. This data shall be able to be harvested with a personal computer at 1-minute intervals.
2. **Logging and Trending Software:** Runtime Logging and Trending software shall be available for harvesting data from the lighting control panels. It shall have a dedicated personal computer connected to the system through a LAN or USB cable to the panel or network controller.
    a) **Load Configuration:** Each relay in the system shall be able to have a wattage load assigned to it to represent the actual load on the relay. Loads shall be able to be named, or names shall be exported directly from the system programming software.
    b) **Combined Loads:** Up to 254 combined relay loads shall be allowed, for total wattage recording of areas in the facility. The combined loads shall allow relays from any panel in the network. Combined loads shall be able to be named for identification in reports and graphs.
    c) **Daily or Monthly Usage Report:** The software shall be capable of generating spreadsheet reports in a daily or monthly format for each relay or combined relays in the system.
    d) **Export Data:** The compiled reports shall be able to be exported to a .csv (comma-separated value) file. These files when exported shall be coded for the year, month, and date.
    e) **Daily or Monthly Usage Graphs:** The software shall be capable of generating usage graphs in a daily or monthly format for each relay or combined relays in the system.
    f) **Printing:** Daily or monthly usage graphs shall have the capability to be directly printed from the software.
    g) **Live Usage Graphs:** The software shall have 1 to 9 live usage meter dials to display the present wattage of combined loads.
    h) **Calendar View:** It shall provide a full-year calendar that shall display the number of calendar events.

R. **Graphical Control Interface (InSite Software):** The software shall be a Windows-based graphical interface that allows monitoring and control of panels using icons on custom or standard graphical screens.

1. **Graphical Background Screens:** Graphical background screen shall consist of any bitmap image with any resolution or number of colors. There shall be virtually limitless numbers of screens with a limit to the capacity of the computer.
2. **Multiple Interfaces:** It shall support an unlimited number of satellite computers controlling the same system. (1 Main computer, multiple remote computers).
3. **Virtual PC:** It shall support web access via a virtual computer.
4. **Fault Log:** It shall log and notify of any relay or network faults.
    a) The software shall monitor itself and restart if there is a communication issue with the system.
    b) It shall automatically send an e-mail to the user(s) notifying them of the problem.
    c) An alarm shall report if a relay does not turn on or off correctly with real-time status updates.
    d) It shall log the loss of communications of each network and every node per network. It shall log when it goes offline and when it goes back online.
5. **Control Icons:** Control icons shall be unlimited per screen and shall be chosen from an extensive library. It shall be able to use custom control icons that can be created and saved as BMP, JPEG, or GIF images. Control icons shall be able to be placed anywhere on the screen and edited at any time. Control icons shall control relays, LL Groups, LL Presets, LL Scenes, LL Timers, or dimmer scenes.

6. **Control Options:** It shall have the following capabilities for control and setup.
   a) **Flood:** It shall have the capability to flood areas or change the color of a defined section of the screen (floor plan) for depicting On/Off states.
   b) **Sounds:** It shall be able to trigger custom sound WAV files for on/off triggers.
   c) **Verify:** There should be settings to verify control action and relay sweep commands.
   d) **Toggle:** This shall be a selectable action for relays which shall include always, never, or selective relays.
   e) **Sweep Enable:** There shall be an option for a sweep command.
   f) **Grid:** A grid shall be available for the design and placement of icons on the screens. This shall be adjustable for size and color, plus it shall be able to allow a snap-to-grid feature.
   g) **Tool Tips:** It shall have an optional Tool Tips option that can display text when hovered over an icon.
   h) **Extra Loads:** It shall have the capability to add extra loads to a single relay control icon.
   i) **Import:** It shall have the capability to import LightLEEDer settings and objects.
   j) **Synchronize InSite Screens:** Remote computers shall have the capability to synchronize screens with a single button push.
   k) **Text Icons:** Text icons can be added to any screen and shall be able to be placed anywhere on the screen and edited at any time. They should be adjustable for size, color, font, and transparency.
   l) **UDP Command:** It shall support UDP command strings for special functions in the system.
7. **Navigation Icons:** These shall have navigation buttons for going from one screen to another. These icons shall have the capability to be Global and be visible on all screens. Icons shall have standard sizes that shall be editable for color, size, and font. It shall be able to use custom control icons that can be created and saved as BMP, JPEG, or GIF images. Navigation icons shall be able to be placed anywhere on the screen and edited at any time.
8. **Sequence Control:** It shall be able to sequences with up to 16 transitions over a 12-hour period for events. It shall be able to turn on/off single relays, LL Groups, set a Preset, or LL Scenes in a sequence.
9. **Dimmer and Motor Control:**
   a) **Single Slider:** Slide dimmers shall be available for single control and/or status of a 0-10V output or an sACN slot.
   b) **Pop-up Multi-Sliders:** It shall have up to 16 pop-up control sliders. Each shall be able to be linked to any dimmer(s) in the system. It shall have the capability to have a slider to control all dimmers, direct or proportional.
   c) **Motor Controls:** It shall be able to create icons for controlling motor controls. Icons shall have standard sizes that shall be editable for color, size, and font. It shall control the motor “positive or negative” from .1 seconds to 300 seconds.
10. **Security and User Access:**
   a) It shall have an Administrator lock-out for specific screens and for specific users during an event in the facility.
   b) It shall support up to 5 levels of user security.
   c) There shall be advanced managed user access for up to 32 users.
   d) A settable administrator timeout shall be settable from 15 minutes to 4 hours.
   e) The Administrator shall be able to assign users’ access and passwords.
11. **Multi Network:** It shall be able to link together up to 32 networks with up to 254 nodes per network to operate as one system.
12. **Schedules:** It shall have programmable schedules that send commands to each network and each node in the system.
   a) It shall have up to 4000 programmable schedules.
   b) It shall automatically control relays, groups, scenes, presets, or trigger a sequence.

c) Schedules shall be based on a fixed time, shared time, or before-at-after sunrise-sunset.
d) It shall have settable Latitude, Longitude, and time-zone settings with adjustable DST settings.
e) It shall have a search option for all schedules that include relays, LL Groups, LL Presets, InSite Presets, and Sequences.

13. **Runtime Monitoring:** It shall incorporate the “Runtime Logging and Trending” software as specified in section “Q”.
14. **Diagnostics Dashboard:** It shall have a tool to monitor all of the relays and devices in the system.
15. **Serial Interfaces:**
    a) **sACN Interface:** It shall have the capability to view sACN via (no interface needed for viewing) and control sACN through an Interactive Technologies Interface optional add-on.
    b) **DMX Control:** It shall have an optional DMX output for lighting fixtures and ILC dimmer outputs
    c) **BACnet IP:** It shall have an optional serial input for status and control from InSite. It shall have up to 750 control points and status for InSite Groups, InSite Presets, or InSite Sequence. It shall have an export to .csv file for documentation.

S. **Emergency UL 924 Lighting Controller Option:** Each lighting controller shall have the option to provide an emergency lighting bypass without the use of external devices. It shall be UL 924 listed and clearly marked.
1. **Bypass Control:** If normal power is lost, if selected, the panel shall force the EM relays to the ON position. It shall also force any 0-10V dimming to 100%.
2. **Control Type:** It shall have the option to select the EM relay control for Force On, Force Off, and No change.
3. **Phase Monitoring:** It shall be able to monitor up to three phases of normal power. Upon loss of any phase, the panel will go into an emergency state. It shall be selectable for each phase monitored. It shall be able to monitor 120/277 VAC circuits.
4. **Isolation:** It shall have barriers to separate Normal and Emergency circuits.
5. **Remote Testing:** It shall be provided with input for remote testing. It shall also be provided an output for driving a remote status LED.

2.2 LIGHTING CONTROLLERS:

A. **Controller:** Each controller shall be designed to be remotely installed and provide control of 4 remote load control relays. This controller shall have the same features as the Programmable Lighting Control Panels excluding add-ons and naming.
1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with a removable screw cover. It shall also be provided with a 1/2" nipple and pre-drilled mounting holes.
2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.
5. **High Voltage Connections:** Each controller shall be provided with 6” wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
6. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, and the relay connections. It shall also be provided push-to-connect

connectors for occupancy sensors, and photo sensor inputs. All connections shall be made to clearly and permanently labeled termination points

7. **Occupancy Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 200mA w/4 devices connected to the controller
   - 160mA w/5 devices connected to the controller
   - 120mA w/6 devices connected to the controller
   - 90mA w/7 devices connected to the controller
8. 60mA w/8 devices connected to the controller

   Photocell Inputs: It shall provide 2 integrated interfaces for ILC photocell heads. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
9. **Local Data Line Port:** It shall provide an RJ45 data line port for up to 61 data line devices. It shall provide power for devices as described in #7 or additional power added with an optional Power Supply Repeater.
10. **Real-Time Clock:** Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.
11. **Pre-Configured Programs:** Each controller shall have up to 16 selectable pre-configured lighting application programs and 1 default contractor program.

B. **Room Controller:** Each controller shall be designed to be remotely installed and provide control of 4 load control relays. This controller shall have the same features as the Programmable Lighting Control Panels excluding add-ons and naming.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with a removable screw cover. It shall also be provided with a 1/2" nipple and pre-drilled mounting holes.
2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.
5. **High Voltage Connections:** Each controller shall be provided with 6” wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
6. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, and the relay connections. It shall also be provided push-to-connect connectors for occupancy sensors, and photo sensor inputs. All connections shall be made to clearly and permanently labeled termination points.
7. **Occupancy Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs.

Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:

- 200mA w/4 devices connected to the controller

8. **Photocell Inputs:** It shall provide 2 integrated interfaces for ILC photocell heads. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
9. **Local Data Line Port:** It shall provide an RJ45 data line port for up to 4 data line devices. It shall provide power for devices as described in #7 or additional power added with an optional Power Supply Repeater.

C. **Integrated -4 -8 Relay Controller:** Each controller shall be designed to be remotely installed and provide control of 4 or 8 integrated load control relays. This controller shall have the same features as the Programmable Lighting Control Panels excluding add-ons and naming.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with a removable screw cover. It shall also be provided with 1/2" knockouts and pre-drilled mounting holes.
2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
5. **Relay Ratings:** It shall be provided with 4- or 8- 50A load relays that shall be de-rated for 16 amps for durability. It shall control 16A for each set of 4 outputs:
   - 16A, 120/277VAC Electronic Ballast (LED)
   - 16A 120/277VAC Tungsten
   - 1/4 HP @ 120 VAC Motor Load
6. **High Voltage Connections:** Each controller shall be provided with terminal blocks for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
7. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, and photo sensor connections. It shall also be provided push-to-connect and screw connectors for occupancy sensors, dimming, and low-voltage inputs. All connections shall be made to clearly and permanently labeled termination points
8. **Occupancy Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 60mA w/4 devices connected to the controller
   - 50mA w/5 devices connected to the controller
   - 40mA w/6 devices connected to the controller
   - 20mA w/7 devices connected to the controller
   - 0mA w/8 devices connected to the controller
9. **Photocell Inputs:** It shall provide an integrated interface for 1 ILC photocell head. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.

10. **Local Data Line Port:** It shall provide an RJ45 data line port for up to 17 data line devices. It shall provide power for devices as described in #8 or additional power added with an optional Power Supply Repeater.
11. **Dimming:** It shall be provided with 4 or 8 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.
12. **Real-Time Clock:** Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.
13. **Pre-Configured Programs:** Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

D. **Integrated 2 Relay Controller:** Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.
1. **Enclosure:** Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½" nipple and mounting tab.
1. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
2. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
3. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
4. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
   - 16A, 120/277VAC Electronic Ballast (LED)
   - 20A 120/277VAC General
   - 1/4 HP @ 120 VAC Motor Load
5. **High Voltage Connections:** Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.
6. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.

   Occupancy Sensor Inputs: It shall have 1 input with power provided. The input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 70mA w/1 device connected to the controller
   - 60mA w/2 devices connected to the controller
   - 50mA w/3 devices connected to the controller
   - 40mA w/4 devices connected to the controller
7. **Photocell Inputs:** It shall provide an integrated interface for 1 ILC photocell head. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.

8. **Local Data Line Port:** It shall provide an RJ45 data line port for up to 17 data line devices. It shall provide power for devices as described in #7 or additional power added with an optional Power Supply Repeater.
9. **Dimming:** It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.
10. **Pre-Configured Programs:** Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

E. **Integrated 2 Room Controller:** Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.
1. **Enclosure:** Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½" nipple and mounting tab.
2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
5. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
   - 16A, 120/277VAC Electronic Ballast (LED)
   - 20A 120/277VAC General
   - 1/4 HP @ 120 VAC Motor Load
6. **High Voltage Connections:** Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.
7. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.
8. **Occupancy Sensor Inputs:** It shall have 1 input with power provided. The input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 70mA w/1 device connected to the controller
   - 60mA w/2 devices connected to the controller
   - 50mA w/3 devices connected to the controller
9. **Photocell Inputs:** It shall provide an integrated interface for 1 ILC photocell head. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
10. **Local Data Line Port:** It shall provide an RJ45 data line port for up to 3 data line devices. It shall provide power for devices as described in #8 or additional power added with an optional Power Supply Repeater.
11. **Dimming:** It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.
12. **Pre-Configured Programs:** Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

2.3 LIGHTING CONTROL RELAYS:

A. **Single Pole Relay:** It shall be designed for controlling high-inrush single pole lighting circuits. It shall employ 4 latching nickel-silver contacts.
   1. **Listing:** Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.
   2. **Labeling:** Lighting control relays shall bear labels for relay current and SCCR ratings.
   3. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
   4. **SCCR:** Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.
   5. **Relay Ratings:** It shall be rated for the following:
      - 16A, 120/277/347 VAC Electronic Ballast (LED)
      - 40A 120/277/347 VAC Ballast
      - 40A 120/277/347 VAC Tungsten
      - 1/5 HP @ 120 VAC Motor Load
      - It shall be suitable for plug-loads
   6. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
   7. **Auxiliary Contacts:** Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.
   8. **Mounting:** Relays shall be capable of panel mounting.
   9. **Lock-Out:** Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.
   10. **Actuator:** Relays shall be equipped with a manual actuator switch for turning the relay ON or OFF along with status indication.

B. **2 and 3 Pole Relay:** It shall be designed for controlling high-inrush 2-, 3-pole lighting circuits. Each pole shall employ 4 latching nickel-silver contacts.
   1. **Listing:** Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.
   2. **Labeling:** Lighting control relays shall bear labels for relay current and SCCR ratings.
   3. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
   4. **SCCR:** Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.
   5. **Relay Ratings:** Each relay shall be designed for the control of 208, 240, and 480 VAC lighting loads at the following per pole.
      - 16A, 120/277/347 VAC Electronic Ballast (LED)
      - 40A 120/277/347 VAC Ballast
      - 40A 120/277/347 VAC Tungsten
      - 1/5 HP @ 120 VAC Motor Load
      - It shall be suitable for plug-loads
   6. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
   7. **Auxiliary Contacts:** Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.
   8. **Mounting:** Relays shall be capable of panel mounting.
   9. **Lock-Out:** Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.
   10. **Actuator:** Relays shall be equipped with a manual actuator switch for turning the relay ON or OFF along with status indication.

11. **Mechanical Link:** Poles within the relay shall be electrically isolated but mechanically linked so as to open and close together without the possibility of one pole being closed while the other remains open. Systems that utilize two single-pole relays to accomplish this function are not acceptable.

C. **Remote Single Pole Relay:** The remote relay shall be designed to be mounted to a junction box or fixture and shall control 1 load up to a 16 Amp circuit.
1. **Listing:** Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.
2. **Plenum:** It shall be plenum rated.
3. **Labeling:** Lighting control relays shall bear labels for relay current and SCCR ratings.
4. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
5. **SCCR:** Lighting relays shall have an SCCR rating of 5,000 amps up to 347 VAC.
6. **Relay Ratings:** It shall be rated for the following:
   - 16A, 120/277/347 VAC Electronic Ballast (LED)
   - 16A 120/277/347 VAC Ballast
   - 16A 120/277/347 VAC Tungsten
   - 16A 120/277/347 VAC Resistive
   - 1/5 HP @ 120 VAC Motor Load
   - It shall be suitable for plug-loads
7. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
8. **Mounting:** It shall have a ½" nipple for mounting to an enclosure or fixture

D. **Remote Single Pole Relay W/Dimming:** The remote relay shall be designed to be mounted to a junction box or fixture and shall control 1 load up to 16 Amp circuit and 0-10V dimming.
1. **Listing:** Lighting control relays shall be individually UL and CUL listed and shall bear labels indicating compliance.
2. **Plenum:** Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.
3. **Labeling:** Lighting control relays shall bear labels for relay current ratings.
4. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
5. **SCCR:** Lighting relays shall have an SCCR rating of 5,000 amps up to 277 VAC.
6. **Relay Ratings:** It shall be rated for the following:
   - 16A, 120/277/347 VAC Electronic Ballast (LED)
   - 16A 120/277/347 VAC Ballast
   - 16A 120/277/347 VAC Tungsten
   - 16A 120/277/347 VAC Resistive
   - 1/5 HP @ 120 VAC Motor Load
   - It shall be suitable for plug-loads
7. **Dimming:** Shall be able to control 0-10V dimming ballast and be able to sink up to 100 mA.
8. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
9. **Mounting:** It shall have a ½" nipple for mounting to an enclosure or fixture

E. **Remote 20 Amp Dimming Relay with Emergency Bypass:** The remote relay shall be designed to be mounted to a junction box or fixture and shall control 2- load up to 20 Amps

circuits and 0-10V dimming. It shall combine normal relay operation with UL924 bypass relay.

1. **Listing:** Lighting control relays shall be individually UL/CUL/UL924 listed and shall bear labels indicating compliance.
2. **Plenum:** Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.
3. **Labeling:** Lighting control relays shall bear labels for relay current ratings.
4. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
5. **SCCR:** Lighting relays shall have an SCCR rating of 5,000 amps up to 347 VAC.
6. **EM Function:** It shall have one normal power relay and one EM relay. Both shall be controlled by a controller. Upon loss of power, the EM relay shall be forced to the ON state. During the EM state, 0-10 V dimming shall be forced to 100%.
7. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
   - 16A, 120/277VAC Electronic Ballast (LED)
   - 20A 120/277VAC General
   - 1/4 HP @ 120 VAC Motor Load
   - It shall be suitable for plug-loads
8. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
9. **Mounting:** It shall have a ½" nipple for mounting to an enclosure or fixture.
10. **Test Button:** It shall have a test button for testing the EM function.
11. **Test Input:** It shall have an input for testing the EM function from a remote location.
12. **Wireless Communications:** It shall have a 915Mhz radio with point-to-point capabilities. It shall communicate 100 feet line-of-sight with the wireless devices.

F. **ILC EM20 Emergency Bypass Relay:** The remote relay shall be designed to be mounted to a junction box or fixture. It shall provide automatic bypass for emergency power.

1. **Listing:** Lighting control relays shall be individually UL/CUL/UL924 listed and shall bear labels indicating compliance.
2. **Labeling:** Lighting control relays shall bear labels for relay current ratings.
3. **SCCR:** Lighting relays shall have an SCCR rating of 5,000 amps up to 2777 VAC.
4. **Loads:** Lighting bypass relays shall be designed for bypass of 120 or 277 VAC @ 20 amps.
5. **Bypass:** It shall automatically bypass normal power upon loss of emergency power
6. **Mounting:** It shall have a ½" nipple for mounting to an enclosure or fixture.

PART 3 EXECUTION

3.1 INSTALLATION

A. **Installation:** Where shown in the drawings, the contractor shall furnish and install programmable lighting controllers of the quantities, sizes, and types shown on the drawings or specified herein.

B. **Requirements:** All equipment shall be installed in accordance with manufacturer requirements and in compliance with all applicable local and national codes and requirements.

3.2 MANUFACTURES SERVICES

A. **Factory Programming:** All controllers shall be factory programmed upon request in accordance with the project specifications prior to shipment.

B. **Installation Assistance:** During the installation process, the manufacturer shall provide, at no cost, technical support via a toll-free telephone line to the installing contractor or owner's representative to answer questions and supply additional information when required.

C. **System Start-Up:** The system manufacturer shall provide a factory authorized field technician to the project site after installation has been completed and prior to the system being energized for the purpose of testing and adjustment of the system. Factory field technician shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 4 weeks prior to scheduling a field technician for the start-up of the system. Should the field technician arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field technician required to complete the system start-up.

D. **On-Site Programming:** During the start-up procedure, the factory field technician shall provide programming assistance and guidance to the building operating personnel to program the systems for initial operation.

E. **Instruction:** During the start-up procedure, the factory field technician shall provide training to the building operating personnel in the operation, programming, and maintenance of the lighting control system.

F. **As-Built Drawings:** After completion of the system installation and testing, the manufacturer shall provide 3 sets of "as-built" drawings.

G. **Operation and Maintenance Manuals:** After completion of the system installation and testing, the manufacturer shall provide 3 sets of Operations and Maintenance Manuals.

H. **Lifetime Telephone Support:** The system manufacturer shall provide a direct telephone number to the system user and shall allow access to free telephone support for the life of the system.

END OF SECTION 26 09 23

SECTION 26 09 26 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:
   1. Time switches.
   2. Indoor occupancy sensors.
   3. Lighting contactors.
   4. Emergency shunt relays.

B. Related Sections include the following:
   1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, manual light switches, and timer wall-switches.

1.2 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.3 SYSTEM DESCRIPTION

A. Permanently installed
   1. Wall switch occupancy sensors
   2. Ceiling mounted occupancy sensors
   3. Switchpacks
   4. Day Lighting Sensor Control

1.4 SUBMITTALS

A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section “Common Work Results for Electrical” for products specified under PART 2 - PRODUCTS.

B. Product Data: For each type of product indicated. Include dimensions, size, voltage ratings and current ratings.

C. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

D. Shop Drawings: Prepared by factory or authorized representative; based on devices proposed for inclusion in the Work. Include dimensioned plans, elevations, and installation details, including the following:
   1. Dimensioned locations of occupancy and light-level sensors.
   2. Coverage patterns for occupancy and light-level sensors.
   3. Interconnection diagrams showing field-installed wiring.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For lighting control device, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation And Maintenance Data," include the following:
   1. Manufacturer's written instructions for adjusting devices after installation.

1.5 QUALITY ASSURANCE

A. Manufacturers Certification for Occupancy Sensor layout: Provide letter from sensor manufacturer stating that locations indicated on shop drawings are arranged to achieve not less than 90 percent coverage of areas indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including but not limited to luminaires, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.7 LIGHTING CONTROL APPLICATIONS

A. Lighting control performance to comply with IECC 2021.
   1. Occupancy/vacancy requirements – Provide an occupancy/vacancy sensors with Manual On/ Automatic Off or Automatic On/ Automatic Off functionality. Spaces with multiple occupants or where line of sight might be obscured ceiling or corner mount sensors and Manual wallstations would be required. Automatic On of lighting via occupancy sensor cannot exceed 50% of lighting in open plan office spaces less than 300ft/sq. Systems that do that allow the user to select Occupancy or Vacancy Mode shall not be acceptable.
   2. Bi-Level switching – Provide multi-level switching and/or variable dimming for maximum energy savings where required. (Qualifies for EPACT tax deductions of $0.60 per foot)
   3. Task Lighting / Receptacle Control – Provide automatic shut off of non-essential plug loads and task lighting in all spaces. Provide Manual On or Automatic On of receptacles whenever spaces are occupied. Receptacle Control will only be shut off when no occupancy is detected within the space. Systems that do not provide receptacle control for a full 20 Amp circuit shall not be acceptable.
   4. Daylight Zones – Primary and Secondary sidelit or toplit areas within an enclosed space shall be controlled in conjunction with other space controls by a multi-level photocontrol device. Adjustments to the daylight zones must be provided by a simple to use, intuitive remote handheld device.
   5. Provide smooth and continuous daylight dimming for areas marked on drawings.
   6. Provide the ability to adjust the high end and low end trim of the dimmers to ensure the lighting automatically provides energy saving even when daylighting calls for full illumination.
   7. Provide the ability for the dimmers and the relays to function separately. Systems where the 0-10V dimmers and relays are tied together reduce design capabilities and shall not be acceptable.

PART 2 PRODUCTS

2.1 SENSOR PERFORMANCE REQUIREMENTS

A. Sensing mechanism:
   1. Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   2. Ultrasonic:
      a. Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
      b. Utilize Doppler shift ultrasonic detection technology.

3. Dual technology:
   a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
   c. Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.

B. Power failure memory:
   1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.

C. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

D. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards.

E. Sensor shall have time delays from 10 to 30 min. Time out shall be set 20 min unless noted otherwise.

F. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

G. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

H. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

2.2 LOW VOLTAGE CEILING MOUNTED VACANCY SENSORS

A. Product: Cooper VAC-DT-2000-R,VAC-DT-1000-R, ILC controls, Leviton

B. Provide all necessary mounting hardware and instructions.

C. Sensors shall be Class 2 devices.

D. When requested, be able to provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology.

E. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

2.3 LOW VOLTAGE CEILING MOUNTED OCCUPANCY SENSORS

A. Product: Cooper OAC-DT-2000-R,OAC-DT-1000-R, ILC controls, Leviton

B. Provide all necessary mounting hardware and instructions.

C. Sensors shall be Class 2 devices.

D. When requested, be able to provide customizable mask to block off unwanted viewing areas

for all ceiling mounted sensors using infrared technology.

E. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

2.4 LINE VOLTAGE CEILING MOUNTED OCCUPANCY SENSORS

A. Product:
   1. Cooper OAC-DT-2000-MV,OAC-DT-2000-DMV

B. Provide all necessary mounting hardware and instructions.

C. Provide a mechanical air-gap on/off function for all sensors.

D. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

E. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

F. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

G. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

H. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

I. Where specified, sensors shall offer daylighting foot-candle adjustment control and be able to accommodate dual level lighting.

J. Where specified, dual relay sensors shall offer daylighting foot-candle adjustment control for either or both relays.

K. Where specified, dual relay sensors shall offer a Bathroom Mode which keeps the second relay ON for an addition 8 minutes after the first relay has been turned off.

L. Sensors shall be RoHS compliant

M. Where specified, sensors shall offer integral Bi-level Automatic On (just one lighting level comes on automatically when occupancy is detected)

2.5 WALL / CORNER MOUNTED SENSORS

A. Product:
   1. QCooper OAWC-P-120W, OAWC-P-120W-R

B. Provide all necessary mounting hardware and instructions.

C. Sensors shall be Class 2 devices.

D. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

E. Where specified, sensors shall offer daylighting footcandle adjustment control

F. Sensors shall be RoHS compliant.

G. Where specified, sensors shall offer integral Bi-level Automatic On (just one lighting level comes on automatically when occupancy is detected)

2.6 VACANCY WALL SWITCHES

A. Product:
   1. Cooper VNW-P-1001-MV-*, VNW-P-1001-DMV-MV

B. Requires Manual On to activate lighting.

C. Cannot be modified to provide Automatic ON capabilities.

D. Provide a mechanical air-gap on/off function for all sensors.

E. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

F. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

G. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

H. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

I. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

J. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from Automatic On to Manual On.

K. Where specified, sensors shall offer daylighting foot-candle adjustment control and be able to accommodate dual level lighting.

L. Where specified, dual relay sensors shall offer daylighting foot-candle adjustment control for either or both relays.

M. Where specified, dual relay sensors shall offer a Bathroom Mode which keeps the second relay On for an addition 8 minutes after the first relay has been turned off.

N. Where specified, sensors shall feature a universally recognized light bulb icon for end user ease of identification of use.

O. Where specified, dual relay sensors shall feature universally recognized light bulb and fan icons for end user ease of identification of use.

P. Sensors shall be RoHS compliant.

Q. Where specified, sensors shall have an EcoMeter that provides a visual indicator of energy usage, increasing end user awareness and reminding individuals to take control of their lighting to maximize energy savings.

R. Where specified, low voltage sensors shall have a Tracking/HVAC Mode that allows the load connected to the Form C BAS relay to remain on when the lights are turned off manually.

S. Where specified, sensors shall have a tamper-proof Automatic Only Mode that automatically turns lighting ON and OFF without requiring a user to push a button.

2.7 OCCUPANCY WALL SWITCHES

A. Product:
   1. Cooper OSW-P-0451-MV-*

B. Provide a mechanical air-gap on/off function for all sensors.

C. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

D. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

E. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

F. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

G. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

H. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from Automatic On to Manual On.

I. Where specified, sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

J. Where specified, dual relay sensors shall offer daylighting footcandle adjustment control for either or both relays.

K. Where specified, dual relay sensors shall offer a Bathroom Mode which keeps the second relay On for an addition 8 minutes after the first relay has been turned off.

L. Where specified, sensors shall feature a universally recognized light bulb icon for end user ease of identification of use.

M. Where specified, dual relay sensors shall feature universally recognized light bulb and fan icons for end user ease of identification of use.

N. Sensors shall be RoHS compliant.

O. Where specified, sensors shall have an EcoMeter that provides a visual indicator of energy usage, increasing end user awareness and reminding individuals to take control of their lighting to maximize energy savings.

P. Where specified, low voltage sensors shall have a Tracking/HVAC Mode that allows the load connected to the Form C BAS relay to remain on when the lights are turned off manually.

Q. Where specified, sensors shall have a tamper-proof Automatic Only Mode that automatically turns lighting on and off without requiring a user to push a button.

2.8 SENSOR SWITCHPACKS

A. Product:
   1. Cooper SP20-MV, SPD20-MV-NO, SPRC-R-20-120, SP-R-20-120

B. Plenum rated

C. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified, TEFLON jacketed cable suitable for use in plenums.

D. Integrated, self-contained unit consisting internally of an isolated load switching control relay.

E. Shall be compatible with incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.

2.9 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG or larger if otherwise required by manufacturer.

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG or larger if otherwise required by manufacturer.

PART 3 EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following field tests and inspections and prepare certified test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time

delays.

B. Lighting control devices that fail tests and inspections are defective work. Remove and replace units that do not pass tests and inspections and retest as specified above.

3.5 ADJUSTING

A. Time-Schedule Adjustments: Times indicated in documents represent initial settings known at time of design documentation. Coordinate final program settings for time-of-day and holiday schedules with Owner prior to Substantial Completion. When requested within 3 months of date of Substantial Completion, provide on-site assistance in adjust schedules to suit Owner. Provide up to one visit to Project during other-than-normal occupancy hours for this purpose.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to one visit to Project during other-than-normal occupancy hours for this purpose.

3.6 CLEANING

A. Clean components according to manufacturer's written instructions.

B. On completion of device box installation but before any wiring devices are installed, inspect interior of boxes and perform the following:
   1. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

C. On completion of wall plate installation, inspect exterior surfaces and perform the following:
   1. Remove paint splatters and other spots.
   2. Replace cracked or damaged wall plates.
   3. Wipe down all wall plates with approve cleaning agent to remove fingerprints and dust.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 09 26

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

1.2 SUBMITTALS

A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section “Common Work Results for Electrical” for products specified under PART 2 - PRODUCTS.

B. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
   1. Include typical manufacturer’s test data reports for each type and size transformer. Reports shall include but not be limited to the following data:
      a. Maximum Efficiency in accordance with DOE 10 CFR PART 431, Subpart K
      b. Efficiency at 50-percent and 100-percent load.
      c. Percent voltage regulation at 80-percent and 100-percent power factor.
      d. Losses in kVA at no load and full load conditions.
      e. Percent X and Percent R values,
      f. Maximum sound level of transformer in enclosure (in dBA).
      g. Maximum 30-Deg hot spot and average temperature rise over a 40 degree C ambient.
      h. Percent Impedance

C. 10 year product warranty certificate

D. Field quality-control test reports.

E. Operation and Maintenance Data: For transformers, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section 01 78 23 "Operation And Maintenance Data," include the following:
   1. Manufacturer's routine maintenance requirements for transformers and all installed components.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer, unless otherwise indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare equipment for shipment.

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

B. Installation Pathway: Coordinate delivery of equipment to allow movement into designated space.
1. Deliver in shipping splits in sizes that can be moved past obstructions in delivery path.
2. Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving equipment into place.

C. Store equipment indoors in clean dry space with uniform temperature in accordance with manufacturer's requirements to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

D. Handle equipment components according to manufacturer's written instructions. Use factory-installed lifting provisions.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor- bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. ABB
3. Square D; Schneider Electric.
4. Siemens

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: High grade, grain-oriented, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses.

C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper

D. Enclosure:
1. Indoors: Type 2
2. Indoors wet location: Type 2 with drip hood

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

C. Cores: One leg per phase.

D. Enclosure for Interior Transformers: Ventilated, NEMA 250, Type 2, unless otherwise indicated.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of a polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces.
   1. Finish Color: ANSI Gray.

F. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 14 kVA: Two 5 percent taps below normal full capacity.

H. Taps for Transformers 15 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

I. Insulation Class: Materials in accordance with NEMA ST20 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
   1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
   2. Include special terminal for grounding the shield.

K. Low-Sound-Level Requirements: Meet NEMA ST 20 standard

1. 0 – 9 kVA → ≤ 40 Db

2. 10 – 50 kVA → ≤ 45 dB

3. 51 – 150 kVA → ≤ 50 dB

4. 151 – 300 kVA → ≤ 55 dB

5. 301 – 500 kVA → ≤ 60 dB

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Transformer Mounting
1. 15 kVA or less: Floor mounted or suspended, as indicated.
2. 30 kVA and 45kVA: floor mounted or suspended, as indicated.
3. 75 kVA: Floor mounted or rack mounted, as indicated.
4. Greater than 75 kVA: Floor mounted, unless otherwise indicated.

3.3 INSTALLATION

A. Comply with NECA 409, “Recommended Practice for Installing and Maintaining Dry-Type Transformers” as published by the National Electrical Contractors Association.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements of Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems.”

C. Construct steel channel support system for rack-mounted or suspended transformers according to manufacturer's written instruction and requirements of Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems.”

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

B. Transformer Nameplates: Label each transformer with Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

3.5 CONNECTIONS

A. Ground equipment according to Division 26 Section 26 05 26 "Grounding and Bonding for Electrical Systems."
1. Ground transformer before it is energized.

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Provide flexible metal conduit with a minimum 12" to a maximum 24” length for wiring connections to transformer enclosure.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare certified test reports:
1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.2 for dry-type transformers. Certify compliance with test parameters.

B. Correct Deficiencies and Report:
   1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace transformers, conductors, units, and devices as required to bring system into compliance.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Prepare a report that identifies transformer, connection, conductors and devices checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

C. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

D. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.7 CLEANING

A. Clean components according to manufacturer's written instructions.

B. On completion of installation, inspect interior and exterior surfaces and perform the following:
   1. Remove paint splatters and other spots.
   2. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
   3. Repair exposed surfaces to match original finish.

3.8 PROTECTION

A. Temporary Heating: Maintain a clean dry space with uniform temperature in accordance with manufacturer’s requirements to prevent condensation. Apply temporary heating as required.

B. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

END OF SECTION 26 22 00

SECTION 26 24 13 - SWITCHBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low-voltage switchboards.

B. Overcurrent protective devices.

1.2 RELATED REQUIREMENTS

A. Section 26 09 13 - Electrical Power Management System

B. Section 26 43 13 - Low-Voltage Power Circuit Breakers

C. Section 26 36 00 - Automatic/Nonautomatic Transfer Switches

D. Section 26 43 13 - Surge Protective Devices for Power Circuits.

1.3 ABBREVIATIONS AND ACRONYMS

A. EMI: Electromagnetic interference.

B. EPMS: Electrical power management system.

C. ERMS: Energy reduction maintenance setting.

D. RFI: Radio-frequency interference.

E. SPD: Surge protective device.

1.4 DEFINITIONS

A. Switchboards may also be identified as SWBD.

1.5 SUBMITTALS

A. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.

B. Indicate deviations from Contract Documents with reference to corresponding drawing or specification number and written justification for deviation.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, components, and accessories.

D. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, instruments, features, and accessories.
   1. Include dimensioned plan and elevation views of switchboards; indicate dimensions, weights, shipping splits, and required clearances.
   2. Include single-line diagram.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Operation and Maintenance Data:
   1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
      a. Include manufacturer, supplier, support, and repair center contact information.
      b. Include manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
      c. Include contact information for parts stocking location closest to Owner.
      d. Identify critical spare parts associated with long lead times and/or those critical to unit operation.
      e. Identify maintenance spare parts required to regularly perform scheduled equipment maintenance including, but not limited to, consumable parts required to be exchanged during scheduled maintenance periods.
   2. Digital Record Keeping:
      a. Provide maintenance logbook application/website available on PC/mobile device to assist in compliance with NFPA 70B.
      b. Include access to manufacturer's standard documentation, equipment serial number, as-built drawings, assembly and testing results, device settings, and spare parts list.
      c. Provide password-protected access to Owner.
      d. Provide access via scannable QR code on front face of equipment.

H. Specimen Warranty: Statement of standard warranty and extended warranty options/costs

I. Project Record Documents:
   1. Configured settings/parameters for adjustable components updated to as-installed and commissioned state, noted if different from factory default.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. Spare Parts: For each type and size of unit installed.
      a. Provide minimum spare parts recommended by manufacturer.
      b. Touch-up paint for finishes.
      c. Package and mark spare parts for long-term storage. Provide separate anti-static containers for printed circuit boards.
   2. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain switchboard components.
      a. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
      b. Portable Test Set: For testing functions of solid state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
      c. Equipment Configuration Software: PC-based or mobile device application; provide one of each different communication interface cable required to connect computer/device configuration and programming.
      d. Equipment Configuration Files: For future upload into replaced/repaired components, in media format acceptable by Owner.

1.6 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70.
   2. Requirements of local authorities having jurisdiction.
   3. Applicable local codes.

B. Manufacturer Qualifications:
   1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 20 years.
   2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
   3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
   4. Certified in accordance with ISO 14001, with product environmental profiles (PEPs) for specified products.

C. Installer Qualifications: Firm with minimum 10 years of experience with equipment of similar type and scope; approved by manufacturer's representative.

D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 WARRANTY

A. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 12 months from substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Schneider Electric; Square D

B. ABB

C. Siemens

D. Eaton Corporation

E. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project

2.2 LOW-VOLTAGE SWITCHBOARDS

A. Switchboard Ratings/Configurations: As indicated on drawings.

B. Switchboard
   1. Available Access: For front only
   2. Incoming Connection Type: As indicated on drawings

C. Switchboard Assemblies:
   1. Comply with NEMA PB 2; list and label as complying with UL 891.
   2. Provide front and rear alignment of adjacent sections.

3. Provide barriers between sections.

D. Short Circuit Current Rating: Where not specified, provide switchgear with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings

E. Ground Fault Protection: List and label as complying with UL 1053.

F. Cable Terminations for Incoming Conductors:
1. Provide lugs in quantity and size required for conductors indicated on drawings.
2. Lug Type: Copper mechanical lugs, suitable for terminating copper conductors only unless otherwise indicated; rate for 167 degrees F (75 degrees C).

G. Bussing:
1. Bus Density Rating: Standard, in accordance with UL 891 temperature rise requirements
2. Bus Material: Hard-drawn, silver-plated copper of 98 percent conductivity unless otherwise indicated.
3. Plating: Apply to bus surfaces except cut edges. Plating on contact surfaces only is not permitted.
4. Phase and Neutral Horizontal Bus: Ampacity equal to or greater than switchboard system rating. Tapered bus is not permitted.
5. Group-Mounted Feeder Vertical Bus Stack:
   a. Provide capability to mount feeder breakers with different frame sizes/poles across from one another on bus stack.
   b. Design to remove nonconducting surface films during circuit breaker installation by wiping action of circuit breaker jaws.
   c. Design in conjunction with circuit breaker jaws to create blow-on forces under fault conditions.
   d. Bolted connections for group-mounted feeder breakers are not permitted.
6. Ground Bus:
   a. Size in accordance with NFPA 70 and UL 891.
   b. Bus Material: Hard-drawn copper of 98 percent conductivity.
   c. Equip with pressure connectors for feeder and branch circuit equipment grounding conductors.
   d. Busway Feeders: Extend insulated equipment grounding cable to busway ground connection. Support cables at intervals in vertical run.

H. Enclosures:
1. Construction: Steel.
2. UL 50E Rating, Unless Otherwise Indicated:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Indoor Locations with Fire Sprinkler Protection: Type 1 with drip hood.
   c. Outdoor Locations: Type 3R.
3. Front Covers: Removable with single tool.
4. Doors: Hinged with removable hinge pins.
5. Finish: Manufacturer's standard paint color over rust-inhibiting primer on treated metal surface.

I. Future Provisions:
1. Future Switchboard Sections: Equip horizontal bus with splicing hardware for

additional switchboard sections.

2. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit breaker compartment.

J. Markings and Labeling:
1. Provide identification and warning labels/nameplates exterior to equipment resistant to weather, UV, and intended installation environment.
2. Provide engraved nameplate identifying project-specific equipment tag and service description.
3. Provide one-line diagram on etched laminate plate.
4. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.
5. Provide scannable QR code on front face of equipment for access to maintenance logbook application/website available on PC/mobile device.

K. Control Power:
1. Control Circuits: 120 VAC control power transformer
2. Control Wiring: Factory install with bundling, lacing, and protection. Provide flexible conductors for size 8 AWG and smaller, across hinges, and for interconnections between shipping units.
3. Electrically Interlocked Main and Tie Circuit Breakers: Connect two control power transformers with interlocking relays to primary side of each control power transformer at line side of associated main circuit breaker. Provide 120 V secondaries connected through automatic transfer relays to enable automatic transfer scheme.

L. Switchboards with Drawout Circuit Breakers: Provide overhead circuit breaker lifting device mounted at top front of switchboard.

M. Maintenance Mode Switches:
1. Description: Local, lockable switch with blue status indicator light that permits selection of maintenance mode with alternate electronic trip unit settings for reduced fault clearing time in accordance with NFPA 70.
2. Provide for circuit breakers 1,200 A and larger unless providing other means of reducing clearing time in accordance with NFPA 70.
3. Switch Type: Provide energy reduction maintenance settings (ERMS) switches where circuit breakers are capable; otherwise provide maintenance mode settings (MMS) switches
   a. ERMS Switches: Clearing time of less than 50 milliseconds when activated.
   b. MMS Switches: Clearing time of less than 80 milliseconds when activated.
4. Insulated Case Circuit Breakers (ICCBs) and Power Circuit Breakers (PCBs) with ERMS: Provide Android/iOS mobile application that enables remote maintenance mode activation, at distance typically greater than 33 feet (10.1 m) line-of-sight.

N. Surge Protective Device (SPD):
1. Externally mounted; refer to SPD/TVSS Specification for more information.

O. Power Metering:
1. Factory installed, integrated within switchboard.
2. Applications:

a. Low-Voltage Mains: Power quality meter
b. Low-Voltage Feeders: Power and energy meter

3. Power Quality Meters:
   a. Capable of monitoring for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting.
   b. Products:
      1) Schneider Electric; PowerLogic ION9000 Meter or equal
4. Power and Energy Meters:
   a. Capable of monitoring for network management, energy cost allocation, asset management, operational efficiency, and compliance reporting.
   b. Products:
      1) Schneider Electric PowerLogic PM5563 Meter or equal

P. Communications:
1. Provide internal wired communications network for connection to Owner's network for power monitoring and equipment status/alarm information via:
   a. Connection to building management system, electrical power management system (EPMS), or other software.
   b. Access to each breaker's embedded web pages through standard web browser for maintenance review, troubleshooting, and monitoring.
2. Communications Protocol: Ethernet Modbus TCP/IP network connected via daisy-chain architecture from each circuit breaker and separate meters (where specified) upstream to switchboard Ethernet port.
3. Embedded Web Pages for Power Circuit Breakers: Provide access to drawout breaker/cradle status (where specified), energy monitoring, historical trending, maintenance indicators/logging, email alerts, and communications diagnostics.
4. Preconfigure and factory-test network communication system with user-configurable final addressing. Provide network drawings with device addresses.
5. Provide software for adjusting circuit breaker trip/alarm points, displaying trip curves, and updating firmware.
6. Internal Network Wiring: Shielded cables with pluggable connectors to facilitate connection across shipping splits.
7. Panel Server:
   a. Capable of acting as solution- and services-enabler for energy management system located on premises or cloud based, remote from building.
   b. Support IEEE 802.11 a/b/g/n (Wi-Fi).
   c. Provide two Ethernet ports, configurable either as bridged ports or separated ports with one IP address for each.
   d. Capable of serving as wired gateway to access downstream serial- and Ethernet-connected Modbus-enabled electrical devices and values in real time.
   e. Support IEEE 802.15.4 (Zigbee) as data concentrator for close distance, wireless devices.
   f. Collects and stores WAGES (Water, Air, Gas, Electricity, Steam) consumption readings.
   g. Provide integral web pages for accessing stored data including views of real-time data for each connected device and summary of connected devices; access to login page via HTPPS.
   h. Designed through secured development lifecycle in accordance with IEC 62443-4-1.
   i. Provide option to disable ports or protocols not used.

Q. Electrical Power Management System Capabilities:
1. Provide communications connectivity and functionality to support electrical power management system (EPMS), including but not limited to:
a. Communications connectivity via Ethernet network and protocols of EPMS and related equipment, either through communications gateway or integral interface.
b. Internal wired communications network for multiple sections/devices to provide single point of connection to EPMS network.
c. Compliance with recognized cybersecurity requirements.
d. Breaker aging modeling for electronic trip circuit breakers.
e. Remote EPMS capability for equipment configuration, operational control, electrical power monitoring, power quality monitoring, compliance, and correction; alarm monitoring with event log.
2. Provide factory-tested native software compatibility, including the following:
a. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data.
b. Pre-mapping of registers to standard measurement names without need for additional configuration or internal device registers.
c. Automatic collection and logging of device data by EPMS software without additional configuration.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:
1. Interrupting Capacity: As required to provide short circuit current rating indicated.
2. Insulated Case Circuit Breakers (ICCBs):
a. Description: Quick-make, quick-break circuit breakers with two-step stored energy closing mechanism; maximum five-cycle closing time.
b. Listed and labeled as complying with UL 489.
c. Construction:
1) Provide fixed-mount circuit breakers unless otherwise indicated
d. Electronic Trip Units:
1) Microprocessor based, with circuit breaker status display and LED trip indicators.
2) Provide energy reduction maintenance settings (ERMS).
3) Provide network monitoring capability for amperage, voltage, power, energy, and harmonics.
4) Provide capability to upgrade by uploading digital modules without requiring replacement/modification of hardware.
5) Where indicated on drawings, provide electronic trip units with field-adjustable long-time, short-time, instantaneous, and ground-fault protection settings.
e. Provide the following where indicated or required:
1) Shunt Trip: Provide 120 VAC coil energized from separate circuit.
2) Auxiliary Contacts: One SPDT switch
3) Undervoltage Release: For tripping circuit breaker between 35 and 75 percent of rated voltage
4) Remote trip indication and control.
5) Key Interlock: Externally mount to prohibit circuit breaker operation; key removable only when circuit breaker is in off position.
f. Control Voltage: 120 VAC
3. Power Circuit Breakers (PCBs):
a. Description: Quick-make, quick-break circuit breakers with two-step

stored energy closing mechanism; maximum five-cycle closing time.

b. Listed and labeled as complying with UL 1066.

c. Construction:

1) Provide fixed-mount circuit breakers unless otherwise indicated

d. Electronic Trip Units:

1) Microprocessor based, with circuit breaker status display and LED trip indicators.

2) Provide energy reduction maintenance settings (ERMS).

3) Provide network monitoring capability for amperage, voltage, power, energy, and harmonics.

4) Provide capability to upgrade by uploading digital modules without requiring replacement/modification of hardware.

5) Where indicated on drawings, provide electronic trip units with field-adjustable long-time, short-time, instantaneous, and ground-fault protection settings.

e. Provide the following where indicated or required:

1) Shunt Trip: Provide 120 VAC coil, energized from separate circuit.

2) Auxiliary Contacts: One SPDT switch for indicating status of circuit breaker contacts.

3) Undervoltage Release: For tripping circuit breaker between 35 and 75 percent of rated voltage

4) Remote trip indication and control.

5) Key Interlock: Externally mount to prohibit circuit breaker operation; key removable only when circuit breaker is in off position.

f. Control Voltage: 120 VAC

4. Molded Case Circuit Breakers (MCCBs):

a. Comply with FS W-C-375; listed and labeled as complying with UL 489.

b. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

c. Circuit Breaker Type:

1) Provide thermal magnetic circuit breakers unless otherwise indicated.

d. Electronic Trip Units:

1) Microprocessor based, with circuit breaker status display and LED trip indicators.

2) Where indicated on drawings, provide electronic trip units with field-adjustable long-time, short-time, instantaneous, and ground-fault protection settings.

3) Provide network monitoring capability for amperage, voltage, and power where indicated.

e. Provide the following where indicated or required:

1. Shunt Trip: Provide 120 VAC coil, energized from separate circuit.
2. Auxiliary Contacts: One SPDT switch for indicating status of circuit breaker contacts.
3. Undervoltage Release: For tripping circuit breaker between 35 and 75 percent of rated voltage
4. Remote trip indication and control.
5. Key Interlock: Externally mount to prohibit circuit breaker operation; key removable only when circuit breaker is in off position.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.

B. Examine for conditions detrimental to completion of work, including:
   1. Verify concrete pads are level and free of irregularities.
   2. Verify installation space is enclosed and weatherproof.
   3. Verify wet work located in or in close proximity to switchboard installation location is completed and dry.
   4. Verify work above ceilings is complete.

3.2 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions.

B. Install switchboards in accordance with NECA 1, NECA 400, and NEMA PB 2.1.

C. Unless otherwise indicated, install and anchor switchboards on raised concrete pad high

D. Set field-adjustable circuit breaker tripping function settings as determined by coordination study.

E. Identify switchboard operating instructions, including but not limited to control and key interlocking sequences and emergency procedures.
   1. Use metal frame with clear acrylic cover. Mount on front of switchboard unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

1. Include necessary material, equipment, labor, and technical supervision.
2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.
3. Identify switchboards with label indicating inspection/testing agency and date of service.

A. Operational Readiness Testing:
   1. Inspect and test equipment and associated systems for conformance to Contract Documents, including equipment manufacturer's recommendations, and readiness for operation.
      a. Visually inspect for physical damage and proper installation.
      b. Perform tests in accordance with manufacturer's instructions.
      c. Perform tests to verify compliance with Contract Documents.
      d. Perform tests to verify equipment is ready for operation.
      e. Touch-up paint chips and scratches with manufacturer-supplied paint.
      f. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
      g. Measure, using high potential testing, insulation resistance of each bus structure phase-to-phase and phase-to-ground for one minute each, at minimum test voltage of 1,000 VDC.
         1) Comply with manufacturer's documented specific testing procedures.
         2) Minimum Insulation Resistance: 1 megohm.
      h. Physically test key interlock systems for proper functionality prior to energizing.
      i. Test continuity of each circuit.
      j. Perform each electrical test and visual/mechanical inspection listed in NETA ATS as applicable. Certify compliance with test parameters.

1) Switchboards: See Section 7.1.
2) Fusible Switches: See Section 7.5.
3) Circuit Breakers: See Section 7.6.
4) Relays: See Section 7.9.
5) Instrument Transformers: See Section 7.10.
6) Meters: See Section 7.11.
7) Ground Fault Protection Systems: See Section 7.14.

B. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.4 CLOSEOUT ACTIVITIES

A. Training:
1. Train Owner's personnel on operation and maintenance of system.
a. Accommodate minimum of twenty attendees.
b. Provide not less than two repeated session(s) with four hours of classroom and hands-on training.
c. Training Reference: Provide manuals and documentation for each participant
d. Instructor: Factory-trained manufacturer's representative.
e. Location: Project site.
2. Provide sufficient time and detail in each session to cover the following at minimum:
a. Operation theory.
b. Major equipment components.
c. Equipment operation.
d. Equipment configurations.
e. Maintenance, troubleshooting, and repair.
f. Component-level parts replacement.

3.5 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes service and distribution panelboards rated 600 V and less, including the following:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

B. Equipment specified in this Section includes distribution equipment that may be installed as part of an Integrated Power System Switchboard. Refer to Drawings for devices that may be installed together as Integrated Power System Switchboard.

1.2 DEFINITIONS

A. DPM: Multifunction Digital-Metering Monitor

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. GFEP: Ground-fault equipment protection.

E. RFI: Radio-frequency interference.

F. RMS: Root mean square.

G. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

A. Overcurrent Protective Device Coordination: All overcurrent protective devices proposed for inclusion in the Work shall be selected to be selectively coordinated with the overcurrent protective devices installed on their supply side such that an overcurrent event (overload, short- circuit, or ground-fault) occurring at the lowest level in the system (branch circuit) cannot cause the feeder protective device supplying the branch circuit panelboard to open. This coordination shall be carried through each level of distribution for all branches of normal and emergency power. Refer to Division 26 Section 26 05 73 "Overcurrent Protective Device Coordination Study" for additional requirements.

1.4 SUBMITTALS

A. Simultaneous Action Submittals: Panelboard Product Data submittal shall be made in conjunction with action submittals required under Division 26 Section “Overcurrent Protective Device Coordination Study.”

B. Product Data: For each type of panelboard, overcurrent protection device, accessory, and related component, include the following:
   1. Manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   2. Rated capacities, features, operating characteristics, furnished specialties, factory settings, accessories and time-current characteristic curves for individual relays and overcurrent protective devices.
      a. Time-current curves for each type of overcurrent protection device. Include hardcopy of characteristic curve and TCC Number for use with Power Tools by

Easy Power. Indicate available setting points and selectable ranges for each type of adjustable overcurrent protection device.

C. Shop Drawings: For each panelboard and related equipment, include the following:
   1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
      a. Tabulation of installed devices with features and ratings.
      b. Enclosure types and details.
      c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
      d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
      e. One-line diagram.
      f. Bus current and voltage ratings.
      g. Short-time and short-circuit current rating of equipment assembly.
      h. Feeder entry locations and lug configuration.
      i. Elevation drawing showing locations for anchor bolts**.**
      j. Nameplate legends.
   2. Wiring Diagrams: For each type of panelboard and related equipment, include the following:
      a. Power, signal, and control wiring.

D. Panelboard Directories: For installation in panelboards.

E. Field quality-control Test Method and Procedure: List of procedures to be used during functional and operations sequence testing. Method of Procedure should include but not be limited to the following:
   1. Tabulation of Testing Equipment and PPE required for tests.
   2. Schedule of Shutdowns required.
   3. Manufacturer’s Recommended Pre-Start Checklists for the following:
      a. Overcurrent Protection Devices
   4. Step-by-Step Testing Operations and Criteria for tests listed below “Field quality-control”.

F. Field quality-control test reports including the following:
   1. Test results that comply with requirements.
   2. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

G. Operation and Maintenance Data: For electrical equipment, accessories and components to be included in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section 01 78 23 "Operation and Maintenance Data," include the following:
   1. Manufacturer's routine maintenance requirements for panelboard and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   3. Time-current curves, including selectable ranges for each type of relay and overcurrent protective device. Include directory listing each adjustable breaker included in the Work and their final set points.
   4. Manufacturer's sample system checklists and log sheets.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and

accessories through one source from a single manufacturer, unless otherwise indicated.
1. Breaker Manufacturer: Manufacturer for breakers shall be the same as the manufacturer of other breakers proposed for other portions of the Work.

B. Product Options: Drawings indicate spatial allocation for panelboards, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum spatial allocation. Refer to Division 01 Section 01 40 00 "Quality Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. Comply with NEMA PB 1 “Panelboards”.

1.6 COORDINATION

A. Coordinate layout and installation of panelboard and components with other construction that penetrates floors, ceilings or walls or are supported by them, including but not limited to conduit, piping, other electrical equipment, light fixtures, HVAC equipment, fire-suppression-system components and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Six spares for each type of panelboard cabinet lock.
2. Touchup Paint: Three 0.5 pint (250 mL) containers of paint matching enclosure finish.
3. Indicating Lights: one for every ten of each type and rating installed. Furnish at least one of each type.
4. Spare Fuses for the following:
   a. Potential Transformer Fuses: One for every ten of each type and rating installed. Furnish at least one of each type.
   b. Control-Power Fuses: One for every ten of each type and rating installed. Furnish at least one of each type.
   c. Fuses for Fusible Power-Circuit Devices: One for every ten of each type and rating installed. Furnish at least three of each type.
5. Molded-Case Circuit Breakers rated 100 amperes and less: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by the following:
1. Cutler-Hammer, Inc.; Eaton Corporation.
2. Siemens
3. ABB
4. Square D; Schneider Electric

2.2 RATINGS

A. Suitable for application in 3-phase, 60-Hz, solidly grounded-neutral system, unless otherwise indicated.

B. Nominal System Voltage: As indicated on the Drawings.

C. Main-Bus: Amperage as indicated on the Drawings. Provide continuous rating across entire length of main-bus.

D. Short-Time and Short-Circuit Current: Match rating of highest-rated overcurrent protective device in panelboard assembly.
   1. Available Short-Circuit Current: As indicated on the Drawings. Refer to Division 26 Section "Overcurrent Protective Device Coordination Study" for additional requirements.

2.3 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets, as indicated. NEMA PB 1.
   1. Rated for environmental conditions at installed location.
      a. Indoor Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   2. Front Cover: Provide the following, unless otherwise indicated:
      a. Hinged Front Cover: Door-in-Door construction with entire front trim hinged to box and with standard door within hinged trim cover to access device handles.
   3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
   4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
   5. Enclosure Finish for Outdoor Units: Factory-applied finish in manufacturer's standard ANSI Gray enamel over corrosion-resistant treatment or rust-inhibiting primer coat, undersurfaces treated with corrosion-resistant undercoating.
   6. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard ANSI Gray enamel over corrosion-resistant treatment or rust-inhibiting primer coat.
   7. Directory Card: Inside panelboard door, mounted in transparent card holder metal frame with transparent protective cover.

B. Incoming Mains Location: Top or bottom.

C. Buses and Connections: Three phase, four wire, unless otherwise indicated.
   1. Phase- and Neutral-Bus Material: Hard-drawn copper, 98 percent conductivity.
   2. Ground Bus: Hard-drawn copper of 98 percent conductivity, Adequate for feeder and branch-circuit equipment ground conductors; bonded to box. Equipped with compression connectors for feeder and branch-circuit ground conductors.
   3. Neutral Buses: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
   4. Bus Size: Comply with UL 489, including allowance for spare circuit breakers and spaces for future circuit breakers. Include bus to extend the full length of vertical sections.
   5. Feed-Through Lugs where indicated on Drawings: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   6. Isolated Equipment Ground Bus, where indicated on Drawings: Adequate for branch-circuit equipment ground conductors; insulated from box.

D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Device Provision:. Provide bussing for full length of enclosure section. All un-used spaces in each panelboard shall be filled spare 20A/1P breakers.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

G. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 22,000 A rms symmetrical.

H. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 25,000 A rms symmetrical.

I. DISTRIBUTION PANELBOARDS
   1. Panelboards: NEMA PB 1, power and feeder distribution type.
   2. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
      a. For doors more than 36 inches high, provide two latches, keyed alike.
   3. Mains: Circuit breaker or Lugs only. As per schedule.
   4. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

J. LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
   1. Panelboards: NEMA PB 1, power and feeder distribution type.
   2. Mains: Circuit breaker or lugs only.
   3. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
   4. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
   5. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
   6. Panelboards that accept plug-on breakers are not permitted.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker Requirements: UL 489, NEMA AB 3, with interrupting capacity rating to meet available fault current.
   1. Thermal-Magnetic Circuit Breakers for 150 amp and smaller unless noted otherwise: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
   2. Electronic trip-unit circuit breakers larger than 150 amp:
      a. RMS sensing
      b. Field-replaceable rating plug or electronic trip
      c. Digital display of settings, trip targets, and indicated metering displays.
      d. Integral test jack for connection to portable test set or laptop computer.
      e. Field-adjustable settings:
         1) Long- and short-time pickup levels.
         2) Long- and short-time time adjustments.
         3) Instantaneous trip.
         4) Ground-fault pickup level, time delay, and I^2t response, where indicated.
         5) Ground-fault indication alarm, where indicated.
         6) Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection and short-time trip function.
   3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   4. GFCI Circuit Breakers: Single- and two-pole configurations with 6-mA trip sensitivity. Provide as indicated and as required by NFPA 70:2020 for personnel protection.
   5. GFEP Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity. Provide as indicated and as required by NFPA 70:2020 for equipment protection.
   6. AFCI Circuit Breakers: Single- and two-pole configurations. Provide as indicated and

as required by NFPA 70:2020 for personnel protection.

B. Molded-Case Circuit-Breaker Features: Standard frame sizes, trip ratings, and number of poles. Provide the following features for all included in the Work:
   1. Lugs: Mechanical style with compression lug kits, suitable for number, size, trip ratings, and conductor material shown on plans.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Lock-Out Tag Provisions: For installing at least three Lock-Out tags on each circuit breaker to secure the breaker and prevent movement mechanism.
   4. Communication Capability: Communication module with functions and features compatible with power monitoring and control system
   5. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

C. Circuit-Breaker Accessories: Standard frame sizes, trip ratings, and number of poles. Provide the following accessories where indicated:
   1. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces where equipment will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.

B. Examine roughing-in of conduits to verify the following:
   1. Wiring entries comply with layout requirements.
   2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 407, “Recommended Practice for the Installing and Maintaining Panelboards” as published by the National Electrical Contractors Association.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards and components once unit is secured in place.

C. Comply with mounting and support requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Mount top of trim 90 inches above finished floor, unless otherwise indicated.

E. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

F. Install overcurrent protective devices, controllers, and instrumentation.

G. Install filler plates in unused spaces.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. For Recessed Panels: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

J. Close unused conduit opening or other unused holes in sides of box with proper mating blank- off plates.

K. Do not use gutters of panelboards as raceways for routing feeder conductors from bottom entrance to top-feed lugs or vice versa; an external gutter or conduit shall be used for this purpose.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Equipment Identification Nameplates: Label each panelboard with engraved Equipment Identification Label as specified in Division 26 Section "Identification for Electrical Systems."

C. Distribution Panelboard Feeder OCPD Labels: Label each OCPD with nameplate that indicates the device it feeds using engraved Equipment Identification Label as specified in Division 26 Section "Identification for Electrical Systems."

D. Panelboard Directory: Create a directory to indicate name/descriptions of installed circuit loads, including final room numbers**.** Obtain approval before installing within clear plastic pocket inside panelboard cover. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

E. Diagram and Instructions:
   1. Frame and mount the following items in clear acrylic plastic holder on the front of panelboard.
      a. Operating Instructions: Printed basic instructions for panelboard, including control and emergency procedures where applicable.
   2. Storage for Maintenance Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:
   1. Inspect panelboard installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
   2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements.
   3. After installing panelboard but before equipment is energized, verify that grounding system at panelboard tests to specified value or better.
   4. Complete installation and startup checks according to manufacturer's written instructions.

C. Correct Deficiencies, Retest and Report:
   1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace

conductors, units, and devices as required to bring system into compliance.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Prepare a report that identifies switchboards, units, conductors and devices checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Set field-adjustable overcurrent protection device trip characteristics according to settings provided by Engineer-of-Record.
   1. Settings will be provided by Engineer-of-Record after the submittal process and review of report required by Division 26 Section 26 05 73 "Overcurrent Protective Device Coordination Study." are completed.

B. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
   1. Measure as directed during period of normal system loading.
   2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Maintain a clean dry space with uniform temperature in accordance with manufacturer’s requirements to prevent condensation. Apply temporary heating as required.

B. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

END OF SECTION 26 24 16

SECTION 26 25 00 - ENCLOSED BUS ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Feeder-bus assemblies.

1.2 SUBMITTALS

A. Shop Drawings: For each type of bus assembly.
   1. Show fabrication and installation details for enclosed bus assemblies. Include plans, elevations, and sections of components. Designate components and accessories, including clamps, brackets, hanger rods, connectors, straight lengths, and fittings.
   2. Show fittings, materials, fabrication, and installation methods for listed fire-stop barriers.
   3. Indicate required clearances, method of field assembly, and location and size of each field connection.
   4. Detail connections to switchgear, switchboards, transformers, and panelboards.
   5. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Submit Coordination Drawings including:
   1. Bus-assembly routing plans and elevations, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
      a. Structural members in the paths of bus assembly.
      b. HVAC, plumbing items, and architectural features in the paths of conduit groups. Denote where systems share common supports.
      c. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
      d. Clearances for access above and to the side of enclosed bus assemblies.
      e. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
      f. Support locations, type of support, and weight on each support.
      g. Location of adjacent construction elements including but not limited to luminaires, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.

C. Product Certificates: For each type of enclosed bus assembly, signed by product manufacturer.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed bus assemblies through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA BU 1, "Busways."

D. Comply with UL 857, "Busways."

E. Comply with NFPA 70.

1.4 COORDINATION

A. Coordinate layout and installation of enclosed bus assemblies and suspension system with other construction that penetrates ceilings or floors or is supported by them, including but not limited to luminaires, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate size and location of concrete curbs around openings for vertical bus. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Products.
   2. ABB
   3. Square D; Schneider Electric.
   4. Siemens

2.2 ENCLOSED BUS ASSEMBLIES

A. Feeder-Bus Assemblies: NEMA BU 1, low-impedance bus assemblies in nonventilated housing; single-bolt joints; ratings as indicated.
   1. Voltage: As Indicated on Drawings
   2. Neutral Capacity: 200 percent rated.
   3. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
   4. Bus Materials: Current-carrying copper conductors, fully insulated with Class 130C insulation except at joints; plated surface at joints.
   5. Ground:
      a. 50 percent capacity ground utilizing integrated housing ground.
   6. Enclosure: Steel or Aluminum with manufacturer's standard finish.
      a. NEMA-3R
   7. Fittings and Accessories: Manufacturer's standard.
   8. Mounting: Arranged flat, edgewise, or vertically without derating.
   9. Provide detailed assembly and installation instructions including NEMA BU1.1 requirements with the equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Do not install enclosed bus assemblies when bus assembly is not protected from moisture.

B. Install enclosed bus assemblies in accordance with the requirements of NEMA BU 1.1.

C. Comply with NECA 408, “Standard for Installing and Maintaining Busways” as published by the National Electrical Contractors Association.

D. Comply with mounting and support requirements specified in Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems."

E. Support bus assemblies independent of supports for other elements including but not limited to equipment enclosures at connections to panelboards and switchboards, pipes, conduits, ceilings, and ducts.

F. Install expansion fittings at locations where bus assemblies cross building expansion joints. Install at other locations so distance between expansion fittings does not exceed

manufacturer's recommended distance between fittings.

G. Construct rated fire-stop assemblies where bus assemblies penetrate fire-rated elements such as walls, floors, and ceilings. Seal around penetrations.

H. Install weatherseal fittings and flanges where bus assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight.

I. Coordinate bus-assembly terminations to equipment enclosures to ensure proper phasing, connection, and closure.

J. Tighten bus-assembly joints with torque wrench or similar tool recommended by bus-assembly manufacturer. Tighten joints again after bus assemblies have been energized for 30 days.

K. Install bus-assembly, plug-in units. Support connecting conduit independent of plug-in unit.

L. Where busway is installed outdoors it shall have a stainless steel custom fabricated shroud places over the bus to prevent rain from collecting on top of the busway. The shroud shall cover the busway until indoors.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Apply Sleeve and Sleeve Seal where raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare certified test reports:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Visual and Mechanical Inspections
      - Verify correct alignment and fit of all busway sections and fittings.
      - Check mechanical and electrical joints for tightness; re-torque to manufacturer’s values.
      - Verify phase sequence and phasing identification.
      - Inspect for proper grounding connections and bonding jumpers across expansion fittings.
      - Verify that firestop and weather seals are installed per UL-listed systems.
   3. Insulation Resistance Testing
      - Perform megger test on each phase bus and ground bus.
      - Test at 1000 VDC for systems up to 600 V.
      - Minimum insulation resistance: 100 megohms or manufacturer’s published value.
   4. Continuity Testing
      - Verify electrical continuity of phase, neutral, and ground buses throughout the entire assembly.
      - Verify bolted joint continuity by low-resistance ohmmeter (DLRO).
   5. Ground-Fault Integrity Testing
      - Verify effective grounding path per NEC 250.4.

- Test continuity of all bonding jumpers, housing grounds, and neutral-to-ground connections (where required).

6. Infrared Thermographic Scan
   - After load energization and 30 days of operation, perform IR scan of all accessible busway joints and connections.
   - Document any hot spots >30°C above ambient; re-torque and retest.

3.5 PROTECTION

A. Temporary Heating: Maintain a clean dry space with uniform temperature in accordance with manufacturer's requirements to prevent condensation. Apply temporary heating as required.

B. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. Provide final protection to ensure that moisture does not enter bus assembly.

END OF SECTION 26 25 00

SECTION 26 25 50 – GENERATOR DOCKING STATION

PART 1 GENERA

1.1. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ETL/UL LISTED to 1008 Standards

C. UL 50 LISTED

1.2. COORDINATION

A. Coordinate layout and installation of Generator Docking Station, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels

1.3. GUARANTEE/WARRANTY

A. Manufacturer Warranty shall be provided for a minimum of 1 Year,
   1. Extended Warranty will be supplied upon at user's request at an additional charge from Manufacturer.

B. The equipment installed under this contract shall be left in proper working order

C. New materials and equipment shall be guaranteed against defects in composition, design or workmanship. Guarantee certificates shall be furnished.

PART 2 PRODUCTS

2.1. DOCKING STATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. TRYSTAR
   2. ASCO

2.2. GENERAL REQUIREMENTS

A. Enclosure
   1. NEMA 3R Rain-Tight Aluminum Enclosure
      a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
      b. NEMA 3R Integrity shall be maintained while temporary cabling is connected during use
      c. Front and Side shall be accessible for maintenance
      d. Top, Side, and Bottom shall be accessible for permanent cabling
   2. Powder coat
      a. Paint after fabrication shall be Hammer tone Gray

B. Phase, Neutral, and Ground Busbar

1. Material: Silver-plated Copper
2. Equipment Ground Bus: bonded to box.
3. Isolated Ground Bus: insulated from box.
4. Ground Bus: 50% of phase size.
5. Neutral Bus: Neutral bus rated 100 percent of phase bus.

C. Temporary generator connectors shall be Camlok style mounted on gland plate.
1. Camlok shall be 16 Series model and color coded according to system voltage requirements.
2. Camlok connections shall be Bus Bar Style, Cabling or Double Set Screw is not acceptable
3. Camlok connection shall be protected against accidental contact while not in use

D. Permanent Connection shall be factory installed broad range set-screw mechanical type, located behind a physical barrier

E. Short Circuit & Withstand Rating
1. Shall be minimum 100 KAIC unless otherwise indicated on drawings

F. Factory Installed Phase Rotation Monitor Device:
1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed

G. Additional accessories shall be included in submittal drawing as follows: A: SCADA Terminal Port

PART 3 EXECUTION

1.1. EXAMINATION

A. Examine elements and surfaces to receive Generator Docking Station for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected

1.2. INSTALLATION

A. Base Mounted
1. Install anchor bolts to elevations required for proper attachment to Generator Docking Station.

B. Provide all necessary interconnections from SCADA Terminal Port to owners Schneider EcoStrucutre SCADA system.

1.3. IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

C. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION

SECTION 26 27 13 - ELECTRICAL MEETING

PART 1 - GENERAL

1.1 SUMMARY

A. Defines all equipment requiring electricity metering.
   1. Distribution panels
   2. Switchgear
   3. All other equipment as noted within electrical drawings

1.2 SCOPE

A. The contractor shall furnish, install, and test the electricity metering system as indicated on the electrical plans, wiring diagrams, panel schedules, and as specified herein.

1.3 REFERENCES

A. UL - Underwriters Laboratories Inc.

B. ETL - Edison Testing Laboratories (Intertek)

C. ANSI C12.1 - Code for Electricity Metering

D. NFPA 70, Article 100

E. NECA 1 - Standard for Good Workmanship in Electrical Construction

F. CSA-C22.2 NO. 61010-1-12

1.4 SUBMITTALS

A. Product Data: Provide dimensions, materials, finishes, and accessories. Describe electrical operating conditions and all features. Include the following:
   1. Electricity metering equipment

B. Manufacturer's Instructions: Include wire diagrams, shop drawings, instructions for handling, examination, preparation, and installation of product(s).

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI C12.1 & NFPA 70, Article 100.

B. Products shall be listed and/or recognized by UL or ETL.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 EQUIPMENT FOR ELECTRICITY SUBMETERING

A. Manufacturers:
   1. Packet Power or approved equal

B. Kilowatt-Hour/Demand Meter: Electronic single- and three-phase meters, measuring

electricity use and demand.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: OLED, indicating accumulative kilowatt hours, current demand, and current (A) load.
3. Communication interface
   a. Web-based user interface to allow review of real time data and enable mass firmware updates.
   b. 3rd party integration via supported protocols (SNMP, Modbus TCP, BACnet, MQTT)
4. Current Transformers: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for ratings of circuits indicated for this application.
   a. Split-core current transformers or Rogowski coils with output of 333mV available for 15-10,000A.
   b. Shunted and individually replaceable via Molex quick disconnect.
   c. Wire lead lengths are customizable and can be extended up to 100’.

2.3 SYSTEM DESCRIPTION - SINGLE ELECTRICITY METER

A. Provides metering of a single circuit for 1P/2W, 2P/3W, 3P/3W, and 3P/4W loads.

B. Meters must be capable of metering all voltage types up to 480V L-L.

C. Metering units must be capable of metering loads between 15A and 10,000A.

D. System accuracy must be +/- 1% or less.

E. Electrical failure powering the device shall not result in a loss of energy cumulation.

F. Metering units support custom CT lead lengths and pre-configured wire harnesses.

2.4 SYSTEM DESCRIPTION - MULTI-CIRCUIT ELECTRICITY METER

A. Provides metering for 1-72 poles for 1P/2W, 2P/3W, 3P/3W, and 3P/4W loads.

B. Metering units must be configurable to meter 72 single-pole circuits, 36 two-pole circuits, or 24 three-pole circuits.

C. Metering units must be configurable to meter 32 single-pole circuits, 16 two-pole circuits, or 10 three-pole circuits.

D. Metering units must be configurable to meter 16 single-pole circuits, 8 two-pole circuits, or 5 three-phase circuits.

E. Meters must be capable of metering all voltage types up to 480V L-L.

F. Metering units must be capable of metering loads between 15A and 10,000A.

G. System accuracy must be +/- 1% or less.

H. Electrical failure powering the device shall not result in a loss of energy cumulation.

I. Metering units support custom CT lead lengths and pre-configured wire harnesses

2.5 SYSTEM DESCRIPTION - BRANCH CIRCUIT ELECTRICITY METER

A. Provides metering for 32-192 poles for 1P/2W, 2P/3W, 3P/3W, and 3P/4W loads.

B. Metering units must be configurable to meter 192 single-pole circuits, 96 two-pole circuits, or 64 three-pole circuits.

C. Metering units must be configurable to meter 128 single-pole circuits, 64 two-pole circuits, or 42 three-pole circuits.

D. Metering units must be configurable to meter 64 single-pole circuits, 32 two-pole circuits, or 21 three-pole circuits.

E. Meters must be capable of metering all voltage types up to 480V L-L.

F. Metering units must be capable of metering loads between 15A and 10,000A.

G. System accuracy must be +/- 1% or less.

H. Electrical failure powering the device shall not result in a loss of energy cumulation.

I. Metering units support custom CT lead lengths and pre-configured wire harnesses

2.6 SYSTEM MEASUREMENTS - SINGLE METER, MULTI-CIRCUIT, BRANCH CIRCUIT

A. Voltage (V) - all phases

B. Amperage (A) - all phases

C. Real Power (W) - all phases

D. Apparent Power (VA)

E. Energy (Wh) - per phase and total

F. Voltage and Current Phase Angle

G. Frequency (Hz)

H. Power Factor (PF)

2.7 METER COMMUNICATIONS AND DATA COLLECTION

A. The Systems shall be as described below:
   1. Consists of wireless communication enabled electricity meters, Ethernet Gateway collection device.
   2. Web based software
      a. Software package shall be web based with no limit to the number of users.
      b. Cloud based software is fully functional without software other than standard web browsers including, but not limited to, Internet Explorer, Google Chrome, and Firefox.
      c. Software shall support an unlimited number of metering points but are billed on a per device basis.
      d. Software shall have the ability to define circuits and display friendly names.
      e. Software shall be used for the collection, analysis, and reporting or energy data
   3. Third party software used to collect and display data or to allow all data collected to IP based applications including third party software such as DCIM, BMS, and billing systems.
   4. Data Acquisition Device
      a. The data acquisition device can be used to verify real-time data from

electricity meters.

b. Device shall operate under the following conditions: 32° to 104°F (0° to 40°C); 10% to 90% non-condensing

c. The device shall use modem and/or Ethernet connections for internet access allowing either static IP or DHCP.

5. No consumer grade protocols such as WiFi, Bluetooth, Zigbee, etc. shall be permitted for wireless data transmission due to security and performance factors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1 and manufacturers' provided manuals

3.2 FIELD QUALITY CONTROL

A. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use test load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at test load connection. Record test results.
5. Repair or replace deficient or malfunctioning metering equipment, or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

END OF SECTION 26 27 13

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Hospital-grade receptacles.
3. Tamper-proof receptacles.
4. Twist-locking receptacles.
5. Snap switches and wall-box dimmers.
6. Wall-box motion sensors.
7. Wall-switch occupancy sensors and time switches.
8. Pendant cord-connector devices.
9. Poke-through assemblies, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. PVC: Polyvinyl chloride.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
1. Receptacles, switches, plates, floor outlets, poke through assemblies, and multioutlet assemblies.

B. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70 latest edition or edition enforced by state or local code authority.

D. Comply with NFPA 99 latest edition or edition enforced by state or local code authority.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Receptacles: Duplex 125 V, 20 A:
   a. Hubbell - HBL 5362.
   b. Leviton Mfg. Company Inc.-5362.
   c. Pass & Seymour-CRB5362.
   d. Pass & Seymour -PT5362A (Plug Tail Device).
2. Receptacles: Duplex: Hospital Grade 125 V, 20 A:
   a. Hubbell - HBL 8300.
   b. Leviton Mfg. Company Inc.-8300
   c. Pass & Seymour-PS8300.
   d. Pass & Seymour -PT8300.
3. Receptacles: Duplex: Hospital Grade Tamper Resistant 125 V, 20 A:
   a. Hubbell - HBL8300SG
   b. Leviton - 8300-SG.
   c. Pass & Seymour - TR63-H
4. GFI Receptacles: Weather Resistant 125 V, 20 A:
   a. Hubbell Incorporated- BR20WR
   b. Leviton Mfg. Company Inc.-WBR20
   c. Pass & Seymour- WR5362.
5. GFI Receptacles: Weather Resistant and Tamper Resistant 125 V, 20 A:
   a. Hubbell - BR2WRTR.
   b. Leviton Mfg. Company Inc.-TWR20
   c. Pass & Seymour- WR20TR.
6. Receptacles: Tamper Resistant 125 V, 20 A:
   a. Hubbell - BR20TR.
   b. Leviton Mfg. Company Inc.-TWR20
   c. Pass & Seymour- TR5362.
7. Switches-Single Pole:
   a. Hubbell- HBL 1221.
   b. Pass & Seymour - PS20AC1.
   c. Leviton Mfg. Company, Inc.- 1221-1
8. Switches-Three Pole:
   a. Hubbell- HBL1223
   b. Leviton Mfg. Company, Inc.-1223-2.
   c. Pass & Seymour-PS20AC3.
9. Switches – Occupancy Sensor Wall Type:
   a. Hubbell - LH-MT
   b. Leviton - OD15-ID
   c. Sensor Switch - WSD-PD
   d. Watt Stopper - WA-200
10. Switches – Key Operated / Security Switches:
    a. Hubbell - HBL1221RKL.
    b. Leviton - 1221-2KL
    c. Pass & Seymour - PS20AC1-KL.
11. Dimmer Switches Line Voltage:
    a. Lutron Nova T
    b. Pass & Seymour CD2000

* Dimmer must be compatible with Ballast or LED Driver.

12. Dimmer Switches 0-10V:
    a. Synergy ISD

b. Cooper SF10P

* Dimmer must be compatible with Ballast or LED Driver.

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with UL 498, 20 amp.

B. Straight-Blade and Locking Receptacles: Heavy-Duty grade 20 amp.

C. GFCI Receptacles: Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

D. Hospital grade and tamper resistant in all patient and pediatric.

E. Tamper resistant in all public areas.

2.3 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
   2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 SWITCHES

A. Single- and Double-Pole Switches: Comply with UL 20, 20 amp.

B. Snap Switches: Heavy-Duty grade, quiet type 20 amp, 120/277 volt.

C. Live Voltage Dimmer: 120V, 2000 watt, slide to-off. Dimmer must be compatible with ballast or driver.

D. 0-10V Dimmer: 120/277VAC, capable of three way, max wattage 1200 w 120VAC, 150000 277 VAC, Dimmer must be compatible with ballast or driver. 100% to 1% continuous.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: As selected by Architect.
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates:
   1. NEMA 250, complying with type 3R weather-resistant while-in-use metalor impact-resistant thermoplastic with lockable cover; non-removable gasket between the mounting plate/base and cover; stainless steel hinges and mounting hardware

2.6 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks.
2. Size: Selected to fit cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 6 voice and data communication cables.

2.7 SPECIAL CONFIGURATION & TWIST-LOCKING RECEPTACLES

A. General: NEMA and Non-NEMA configurations as indicated on Drawings.
   1. Comply with NEMA WD 1, NEMA WD 6; and UL 498.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell
      b. Leviton
      c. Pass & Seymour

2.8 MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Incorporated; Wiring Device-Kellems.
   2. Wiremold Company

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles. Power receptacles meeting the requirements for receptacles listed in this section above, unless otherwise indicated.

C. Raceway Material: As indicated on Drawings.

D. Finish: As selected by Architect

E. Wire: No. 12 AWG, unless otherwise noted.

F. Power Receptacle:Devices as indicated on Drawings

G. Voice and Data Communication Outlet: Devices as Indicated on Drawings.

2.9 FINISHES

A. Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.2.
   2. Wiring Devices Connected to Emergency Power System: Red.
   3. If there is UPS furnished by T.G.HS with outlets not in the UPS, receptacle needs to be blue.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

C. Remove wall plates and protect devices and assemblies during painting.

D. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

E. Install weather resistant receptacles in damp and wet locations per N.E.C. requirements.

F. Mounting Heights: Comply with applicable codes and requirements of Authorities Having Jurisdiction. Mount devices as indicated on Drawings, including but not limited to Architectural elevations. Coordinate all above counter receptacles with backsplash to avoid interferences. All dimensions are given to centerline of box above finished floor (AFF), unless otherwise indicated.

G. Device Plates and Covers:
   1. Do not use oversized or extra-deep plates.
   2. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
   3. Install weather-proof-while-in-use covers over receptacles in wet, damp and exterior locations.
   4. Group adjacent devices under single, multigang wall plates.

H. Floor Service Outlets, Service Poles and Poke-Thru Device
   1. Adjust locations of floor service outlets and Poke-Thru devices to suit arrangement of partitions and furnishings. Coordinate revised location with Structural Engineer.

3.2 APPLICATION

A. Receptacles in Patient Care Areas: Install Hospital Grade devices where device is located within a Patient Care Area as defined by NFPA 70 Article 517 or the Authorities Having Jurisdiction.

B. GFCI Receptacles: Install in locations as indicated but in no case less than those listed below:
   1. Where device is located on the exterior of the building, provide with Wet-Location Weatherproof Cover Plate.
   2. Where device is located within kitchen.
   3. Where device is located in an elevator pit.
   4. Where device is located within 6 feet (2-m) of a lavatory or sink

C. Tamper-Resistant Receptacles: Install in locations as indicated but in no case less than those listed below:
   1. Public Lobbies.
   2. Waiting Rooms.
   3. Play Rooms and other similar rooms that children are expected to occupy.

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.5 CLEANING

A. On completion of wall plate installation, inspect exterior surfaces and perform the following:
1. Remove paint splatters and other spots.
2. Remove all temporary markings and labels.
3. Replace cracked or damaged wall plates.
4. Wipe down all wall plates with approve cleaning agent to remove fingerprints and dust.

END OF SECTION 26 27 26

SECTION 26 28 11 - LOW-VOLTAGE POWER CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low-voltage power circuit breakers.

1.2 Related Requirements

A. Section 26 09 13 - Electrical Power Management System

B. Section 26 24 13 - Switchboards - Schneider Electric Square D FlexSeT / QED-2.

1.3 ABBREVIATIONS AND ACRONYMS

A. LVPCB: Low-voltage power circuit breakers.

B. ERMS: Energy reduction maintenance setting.

C. HMI: Human machine interface.

1.4 DEFINITIONS

A. Operator Interface Terminal (OIT): Locally mounted HMI device that provides remote monitoring and functions of connected equipment.

1.5 SUBMITTALS

A. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.

B. Indicate deviations from Contract Documents with reference to corresponding drawing or specification number and written justification for deviation.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.

D. Manufacturer's qualification statement.

E. Operation and Maintenance Data:
   1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
      a. Include contact information for parts stocking location closest to Owner.
      b. Identify critical spare parts associated with long lead times and/or those critical to unit operation.

F. Specimen Warranty: Statement of standard warranty and extended warranty options/costs.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. See Section 016000 - Product Requirements for additional provisions.
   2. Spare Parts: For each type and size of unit installed.
      a. Provide minimum spare parts recommended by manufacturer, including trip coils, switches, and spring charging motors.
      b. Package and mark spare parts for long-term storage. Provide separate anti-static

containers for printed circuit boards.

3. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain circuit breakers and components.
   a. Equipment Configuration Software: PC-based or mobile device application; provide one of each different communication interface cable required to connect computer/device for configuration and programming.

1.6 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70.
   2. Requirements of local authorities having jurisdiction.
   3. Applicable local codes.

B. Manufacturer Qualifications:
   1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 10 years.
   2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
   3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
   4. Certified in accordance with ISO 14001, with product environmental profiles (PEPs) for specified products.

1.7 Warranty

A. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 12 months from date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Schneider Electric; Square D

B. ABB

C. Siemens

D. Eaton Corporation

E. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project

2.2 LOW-VOLTAGE POWER CIRCUIT BREAKERS

A. Listed as complying with UL 1066.

B. Provide sealed low-voltage power circuit breaker (LVPCB), operated as indicated on drawings , with integrally mounted electronic trip units.

C. Provide fixed or drawout mounted as indicated on drawings circuit breakers.
   1. Drawout Mounted Circuit Breakers: Provide racking mechanism integral to stationary circuit breaker chassis to reduce movable weight and improve serviceability. When racking mechanism is integral to circuit breaker, provide spare breaker per frame.

D. Circuit Breaker Rating: 100 percent rated.

E. Interrupting Rating: Available up to 130 kAIR RMS at 635 V, 200 kAIR RMS at 508 V, and 200 kAIR RMS at 254 V without fuses.

F. Thirty-Cycle Withstand Ratings: Comply with application requirements.

G. Close-and-Latch Rating: Up to 150 kA peak current.

H. Maximum Closing Time:
   1. Provide maximum 5-cycle closing time.
   2. Ratings Less than 800 A: 50 milliseconds.
   3. Ratings Between 800 A and 4,000 A: 70 milliseconds.
   4. Ratings Greater than 4,000 A: 80 milliseconds.

I. Service Life:
   1. Frame Size of 3,200 A or Less: Certified for 10,000 operations without maintenance.
   2. Frame Size Greater than 3,200 A: Certified for 5,000 operations without maintenance.
   3. Provide visual contact wear indicator.

J. Operation:
   1. Provide two-step, fully-stored energy devices for quick-make, quick-break operation.
      a. Capable of open-close-open cycle without recharging.
      b. Automatically charge motor operator when breaker is closed.
      c. Step One: Actuation of operating handle or operation cycle of circuit breaker motor charges closing springs.
      d. Step Two: Operation of local close button closes circuit breaker contact, automatically charging opening springs.
   2. Anti-Pumping Function: Remains in open position if opening/closing commands occur simultaneously; after fault tripping or intentional opening using manual or electrical controls, requires closing order to be discontinued and reactivated.
   3. Provide OPEN and CLOSE buttons with lockable clear cover.
   4. Provide breaker contact and close spring status indicators; indicate "charged-not OK to close" if closing springs are charged but circuit breaker is not ready to close.
   5. Locking Provisions: For locking in connected, test, or disconnected position.
      a. Pad-Lock Provisions: One to three.
      b. Key-Lock Provisions: One to two.
   6. Support auxiliary status contacts for open/close (ON/OFF), tripped, ready to close, ready to open, and spring mechanism is charged to provide local or remote indications of proper breaker system functionality.
   7. Provide safety interlock to keep circuit breaker open if trip unit is not installed.
   8. Shunt Trip and Shunt Close Coils: Continuous-duty rated; intermittent duty rated coils dependent on coil clearing contact may be used where spare coil is provided for each breaker.

K. Construction:
   1. Case: Polyester thermoset material with high dielectric strength.
   2. Current-Carrying Components: Isolated from accessory mounting area and double-insulated from operator with accessory cover in place.
   3. Isolate each phase and ground.
   4. Equipped with metal filters to reduce effects of interruption on surfaces surrounding circuit breaker.
   5. Comply with Registration Evaluation and Authorization and Restriction of Chemicals (REACH) and Restriction of Hazardous Substances (RoHS).

L. Electronic Trip Units:
   1. Digital Modules:

a. Provide capability to upgrade trip unit functions by uploading digital modules without requiring replacement/modification of hardware.
b. Electronically manage trip unit protection functions independently of measurement functions by dedicated application-specific integrated circuit (ASIC).
c. Support uploading of digital modules to trip unit without removing power from circuit breaker.

2. Provide local and remote trip indication with cause of trip (e.g., overload, short circuit, or ground fault).
3. Visually indicate circuit breaker operating status (normal, warnings, alarms, energy reduction maintenance setting) via color-changing backlit display.
4. Provide capability to set breaker locally, via smart mobile device, or remotely through communications.
5. Provide sealable door to block use of local display for deterrence of unwanted protection setting changes.
6. Support extraction of trip cause data from trip unit and adjustment of protection settings without 24 VDC power supply or when main circuit breaker is OFF using portable power supply connected through USB port, including battery pack, smart mobile device (USB OTG), or laptop PC.
7. Provide true RMS sensing through 40th harmonic; indicate long-time pickup with LEDs.
8. Coils: Provide status, self-diagnostics (functionality and number of coil operations), and wiring diagnostics. Coils without these features to be provided with separate system to communicate status/alarms to remote monitoring system.
9. Where indicated on drawings, provide electronic trip units with the following field-adjustable protection settings:
    a. Long-Time (ANSI 49RMS/51):
        1) Pickup: Adjustable from 40 to 100 percent of nominal current rating in 1 A increments; where 1 A increments are not possible, provide complete set of rating plugs for each breaker.
        2) Delay: Adjustable from 0.5 to 24 seconds at 600 percent of long-time pickup in 0.5-second increments.
    b. Short-Time (ANSI 50TD/51):
        1) Pickup: Adjustable from 150 to 1,000 percent of long-time pickup in increments of 1 percent.
        2) Delay: Adjustable from 10 to 40 percent of I2t for ON and 0 to 40 percent of I2t for OFF in increments of 0.1 second.
    c. Instantaneous (ANSI 50):
        1) Pickup: Adjustable from 150 percent to 1,500 percent of nominal current rating.
        2) Provide OFF setting where short-time pickup is also provided.
        3) Selectable Breaking Times:
            (a) Standard: For selective coordination.
            (b) Fast: For limiting let-thru energy; between 25 and 30 milliseconds.
    d. Ground-Fault (ANSI 50N-TD/51N):
        1) Available for solidly grounded 3-phase, 3-wire or 4-wire systems.
        2) Types Supported: Residual, source ground return, and modified differential.
        3) Circuit Breakers 1,200 A or Less: Adjustable pickup from 20 to 100 percent of nominal current rating in 10 percent increments.
        4) Circuit Breakers Greater than 1,200 A: Adjustable pickup from 500 A to 1,200 A.
        5) Provide independent ground fault alarm, with separate setting.
10. Where required for selective coordination as determined by power system study, provide inverse definite minimum time lag (IDMTL) to enable adjustment of long-time

delay protection slope.

11. When voltage(s) exceeds upper or lower limits, circuit breaker trips
12. Provide active power function to trip circuit breaker when active power is negative and exceeds settings.
13. Provide dual trip curve settings for each protection function (LSIG) with separate settings for utility, generator set, or grid sources; selectable by digital input through I/O module, Ethernet, or local display.
14. Energy Reduction Maintenance Setting (ERMS):
    a. Trip Unit: Provide separate trip curve for arc energy reduction maintenance setting selected via physical selector switch or smart mobile device; operate in fast instantaneous trip mode (25 to 30 milliseconds), when trip curve is active.
    b. Limit access to engaging/disengaging ERMS mode or changing settings using padlocks or passwords.
    c. Provide remote indicator light to indicate trip unit is in ERMS mode.
15. Measurement and Analysis Functions:
    a. Provide trip unit embedded measurement for real-time metering. Where trip unit embedded measurement is not available, provide external meter.
    b. Metering Accuracy:
        1) Current and Voltage: 0.5 percent.
        2) Power and Energy: 1 percent.
        3) Specified accuracies are for total measurement system, including CT and meter.
        4) Full scale over range of 10 to 120 percent of long-time pickup.
    c. Energy Measurement:
        1) Imported and exported energy on each phase of power system network.
        2) Active, reactive, and apparent energy, per phase and total.
    d. Harmonic Analysis and Waveform Capture: Individual harmonics of voltages and currents up to 40th harmonic, calculated every 200 milliseconds in accordance with IEC 61000-4-30.
    e. Support display of measurements on breaker HMI display, smart mobile device via Bluetooth, connected remote operator interface terminal, or remote monitoring system via Modbus TCP/IP.
    f. Event Management:
    1) Provide event management to assist in compliance with NFPA 70B.
        2) Provide notification of alarms and traceability, including event history of trips, protection setting changes, diagnostics, metering, configuration, and operation.
        3) Record date and time entry was made and user ID associated with change.
        4) Support alarm activation based on measurement or counters.
        5) Support availability of events by communication via Bluetooth and Modbus TCP/IP or by software engineering tool.
    g. Internal Monitored Functions:
        1) Circuit Breaker: Coil electrical continuity checks, circuit breaker closing time, gear motor charging time, circuit breaker closing and opening counter, circuit breaker time stamp closing and opening history log.
        2) Trip Unit: Internal sensor continuity (CTs), external sensor disconnection (ENCT, ground-fault sensor, I/O modules), internal failure discrimination (ASIC, sensor plugs, internal battery, trip solenoid), wireless communication failure (Bluetooth low energy, Ethernet).
16. Smart Mobile Device App:
    a. Communicate trip cause information to smart mobile device without requiring power to trip unit.
    b. Provide virtual assistance in reclosing breaker after trip event utilizing information extracted from breaker, including waveform capture on trip event.
    c. Display circuit breaker event information, potential trip causes, list of additional

investigations needed to determine if power can be restored, and recommendations for power restoration.

17. Auto-Test Function: Monitor and communicate trip unit state, battery state, contact state, circuit breaker remaining life estimate (algorithm based), opening/closing function, and spring charging function; indicate by health state LED, embedded HMI display, and smart mobile device app.
18. Support remote open/close operation via wired communication.
19. Communications:
    a. Provide USB communication/test port to check electronic and trip mechanism operation without requiring manufacturer's special hardware tool.
    b. Provide wireless communication interface for protection settings and health checks using near field communications (NFC) and Bluetooth low energy (BLE) protocols.
    c. Provide communication interface with two Modbus TCP/IP 10/100 Mbps ports (dual-port, single network) for connection to Ethernet network for real-time access to data and settings.
    d. Provide embedded web page interface accessed via standard PC and web browser without requiring additional hardware or software.
    e. Comply with Device Profile for Web Services (DPWS) for auto-discovery on local area network (LAN).
    f. Capable of reporting drawout circuit breaker cradle position, viewable in embedded web page and over data connection to external monitoring software.
    g. Trip unit and communication accessories for all Ethernet network accessible LV circuit breakers shall comply with cyber security global standards such as ISA/IEC 62443-4-1, ISA/IEC 62443-4-2, US cyber security regulations SB327, HB2395, NFPA 70 (NEC) 240.6 (D), UL 5500, DODI 8510.01, US data privacy regulations, and shall be part of a certified ISA/IEC 62443-3-3 reference architecture.

M. Operator Interface Terminal:
1. Provide locally mounted operator interface terminals (OIT) remote from circuit breaker for each group of circuit breakers connected via Ethernet network.
    a. Provide real-time display of monitored devices.
    b. Support simple control of devices and load.
    c. Circuit Breaker Functions Displayed:
        1) Energy consumption.
        2) Electrical network data.
        3) Alarms and events.
        4) Energy quality.
        5) Device status (e.g., open, close, and tripped), indication of fault types (e.g., LT, ST, instantaneous, and ground fault), faulty phases, and interrupted current.
        6) Predictive maintenance monitoring contact wear rate, load profile, and circuit breaker counter values.

N. Electrical Power Management System Capabilities:
1. See Electrical Power System Management specification for additional requirements.
2. Provide communications connectivity and functionality to support electrical power management system (EPMS), including but not limited to:
    a. Communications connectivity via Ethernet network and protocols of EPMS and related equipment, either through communications gateway or integral interface.
    b. Remote EPMS capability for equipment configuration, operational control, electrical power monitoring, power quality monitoring, compliance, and correction; alarm monitoring with event log.
3. Provide factory-tested native software compatibility, including the following:
    a. Capability for pre-engineered, interactive graphical display screens to view and

analyze real-time device data.

b. Pre-mapping of registers to standard measurement names without need for additional configuration or internal device registers.

c. Automatic collection and logging of device data by EPMS software without additional configuration.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.

B. Examine for conditions detrimental to completion of work.

3.2 INSTALLATION

A. Install circuit breakers in accordance with manufacturer's written instructions.

END OF SECTION 26 28 11

SECTION 26 28 13 - FUSES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Cartridge fuses rated 600 V and less for use in switches and controllers.

1.2 PERFORMANCE REQUIREMENTS

A. Overcurrent Protective Device Coordination: All overcurrent protective devices proposed for inclusion in the Work shall be selected to be selectively coordinated with the overcurrent protective devices installed on their supply side such that an overcurrent event (overload, short- circuit, or ground-fault) occurring at the lowest level in the system (branch circuit) cannot cause the feeder protective device supplying the branch circuit panelboard to open. This coordination shall be carried through each level of distribution for all branches of normal and emergency power. Refer to Division 26 Section "Overcurrent Protective Device Coordination Study" for additional requirements.

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:
   1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   2. Let-through current curves for fuses with current-limiting characteristics.
   3. Time-current curves, coordination charts and tables, and related data. Include hardcopy of characteristic curve and TCC Number for use with Power Tools by Easy Power.
   4. Tabulated schedule which indicates type, characteristics, and ratings of individual fuses and lists the devices and equipment in which they will be applied.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size. Provide fuses to match utilization equipment requirements.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Quantity equal to one for every ten of each type and rating installed. Furnish at

least three of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Bussman, Inc.
   2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
   3. Ferraz Shawmut, Inc.
   4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

B. End Caps: End caps shall be capable of being tested if fuse is blown.

C. Indicating Feature: Fuse shall have an indicating feature which clearly indicates when fuse is blown.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Motor Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

B. Install labels indicating Type and Rating of fuse installed on outside of door of each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers.
   4. Enclosures.

1.2 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. GFEP: Ground-fault equipment protection.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   1. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Time-current curves for each type of overcurrent protection device. Include hardcopy of characteristic curve and TCC Number for use with Power Tools by Easy Power. Indicate available setting points and selectable ranges for each type of adjustable circuit breaker.

B. Shop Drawings: For each enclosed circuit breaker, switch and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of device and overcurrent protective devices.
   2. Wiring Diagrams: Power, signal, and control wiring.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories through one source from a single manufacturer, unless otherwise indicated.
   1. Breaker Manufacturer: Manufacturer for breakers shall be the same as the manufacturer of other breakers proposed for other portions of the Work.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Consumer and Industrial Division.
   3. Square D/Group Schneider.
   4. Siemens

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

E. Fuses are specified in Division 26 Section "Fuses."

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Square D/Group Schneider.
   4. Siemens

B. Molded-Case Circuit Breaker Requirements: UL 489, NEMA AB 3, with interrupting capacity rating to meet available fault current.
   1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   2. Electronic trip-unit circuit breakers: RMS sensing, field-replaceable rating plug, and the following field-adjustable settings:
      a. Long- and short-time pickup levels.
      b. Long- and short-time time adjustments.
      c. Instantaneous trip.
      d. Ground-fault pickup level, time delay, and I^2t response, where indicated.
      e. Ground-fault indication alarm, where indicated.
   3. GFCI Circuit Breakers: Single- and two-pole configurations with 6-mA trip sensitivity. Provide as indicated and as required by NFPA 70 for personnel protection.

4. GFEP Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity. Provide as indicated and as required by NFPA 70 for equipment protection.
5. Plug on breakers shall not be permissible.

C. Molded-Case Circuit-Breaker Features: Standard frame sizes, trip ratings, and number of poles. Provide the following features for all included in the Work:
1. Lugs: Mechanical style with compression lug kits, suitable for number, size, trip ratings, and conductor material; UL 486 B listed, dual rated and marked for use with copper- or aluminum load-side conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Lock-Out Tag Provisions: For installing at least three Lock-Out tags on each circuit breaker to secure the breaker and prevent movement mechanism.
4. Plug on breakers shall not be permissible.

D. Circuit-Breaker Accessories: Standard frame sizes, trip ratings, and number of poles. Provide the following accessories where indicated:
1. Ground-Fault Protection: Provide integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

E. Molded-Case Switch Features and Accessories:
1. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location as follows, unless otherwise indicated:
1. Indoor Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R,
3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

B. Enclosure Finish for Outdoor Units: Factory-applied finish in manufacturer's standard ANSI Gray enamel over corrosion-resistant treatment or rust-inhibiting primer coat, undersurfaces treated with corrosion-resistant undercoating.

C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard ANSI Gray enamel over corrosion-resistant treatment or rust-inhibiting primer coat.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces where equipment will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.

B. Examine roughing-in of conduits to verify the following:
1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Fused Power Circuit Device Operating Mechanism: Mechanical Trip, except Electrical Trip for switches with ground-fault protection or remotely tripped switches.

B. Molded-Case Circuit Breakers OCPD Type: Adjustable Instantaneous-Trip Circuit Breakers, unless otherwise indicated.

3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Comply with mounting and support requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.

E. Anchor floor-mounting switches to concrete base.

F. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

G. Mount plumb and rigid without distortion of box. Mount recessed equipment with fronts uniformly flush with wall finish.

H. Install overcurrent protective devices, controllers, and instrumentation.

I. Install filler plates in unused spaces.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

K. Close unused conduit opening or other unused holes in sides of box with proper mating blank- off plates.

L. Do not use gutters of equipment as raceways for routing feeder conductors from bottom entrance to top-feed lugs or vice versa; an external gutter or conduit shall be used for this purpose.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved Equipment Identification Label as specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each equipment bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

3.6 ADJUSTING

A. Set field-adjustable overcurrent protection device trip characteristics according to settings provided by Engineer-of-Record.

3.7 CLEANING

A. Clean components according to manufacturer's written instructions.

B. Prior to installation of front trim and cover plates inspect interior surfaces and perform the following:
   1. Remove paint splatters and other spots.
   2. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

C. On completion of front trim and cover installation, inspect exterior surfaces and perform the following:
   1. Remove paint splatters and other spots.
   2. Remove all temporary markings and labels.
   3. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
   4. Repair exposed surfaces to match original finish.

END OF SECTION 26 28 16

SECTION 26 32 13 - DIESEL GENERATOR SETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged engine-generator sets suitable for use in commercial healthcare applications with the features as specified and indicated. Engine generators will be used as the Standby power source for the system, the generator shall supply life safety and optional standby loads.

1.3 DEFINITIONS

A. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.

B. Prime Power (PRP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously while supplying a variable electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the PRP unless otherwise agreed by the RIC engine manufacturer.

C. Limited Time running Power (LTP): Per ISO 8528: The maximum power available, under the agreed operating conditions, for which the generating set is capable of delivering for up to 500 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers.

D. Continuous Operating Power (COP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously while supplying a constant electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer.

E. Data Center Continuous (DCC): The maximum power which a generating set is capable of delivering continuously whilst supplying a variable or constant electrical load when operated for an unlimited number of hours in a data center application under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 100 percent of the DCC rating.

F. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.
3. Sound test data, based on a free field requirement.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Wiring Diagrams: Control interconnection, Customer connections.

C. Certifications:
1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.
1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
3. List of factory tests to be performed on units to be shipped for this Project.
4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.

B. Warranty:
1. Submit manufacturer’s warranty statement to be provided for this Project.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain a service center capable of providing training, parts, and emergency maintenance repairs within 12 hours of reported problem.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).

E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).

F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.

G. Comply with UL 2200.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: 4.44 deg C (40.0 deg F) to 51.11 deg C (124.0 deg F).
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 60.0 feet (18.29 m).

1.8 WARRANTY

A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months from substantial completion.

B. Extended Warranty: Manufacturer shall offer extend coverage of 5 years from date of registered commissioning and start-up.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: The following manufacturers are approved. All others shall seek prior approval.
1. Cummins Power Generation
2. MTU
3. Taylor Power

B. Automatic Transfer Switch: Generator must be furnished with an ASCO transfer switch. No substitutions shall be permitted.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.

C. Capacities and Characteristics:
1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 750.0kw, at 80 percent lagging power factor, 277/480, Series Wye, Three phase, 4 -wire, 60 hertz. Output breaker rating shall be: 1200/3P
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:
1. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 seconds.
3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 3 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals,

system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.

8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.3 ENGINE

A. Fuel: ASTM D975 #2 Diesel Fuel

B. Rated Engine Speed: 1800RPM.

C. Lubrication System: The following items are mounted on engine or skid:
   1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
   2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
   3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions

E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

F. Integral Panelboard: Generator shall include integral 208Y/120V 3Ø 4W panelboard. Panelboard shall be pre-wired to Coolant Jacket Heater, battery charger, unit lighting, etc. Contractor shall connect panelboard to life safety panel as indicated on plan.

G. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
   1. Designed for operation on a single 480 VAC, Three phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.
   2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
   3. Provided with a 24VDC thermostat, installed at the engine thermostat housing

H. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

I. Cooling System: Closed loop, liquid cooled
   1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.
   2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.

J. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.

K. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

L. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
   a. Operation: Equalizing-charging rate based on generator set manufacturer’s recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
   b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
   c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
   d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
   e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
   f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be listed and labeled. The fuel tank shall include the following features:

1. Capacity: Fuel for 96 Hour(s) continuous operation at 100 percent rated power output.
2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
3. Electrical stub up(s)
4. Normal & emergency vents
5. Lockable fuel fill
6. Mechanical fuel level gauge
7. High and low level switches to indicate fuel level
8. Leak detector switch
9. Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
10. Fill port with overfill prevention valve (OFPV)
11. 5 gallon fill/spill dam or bucket
12. Tank design shall meet the regional requirements for the Project location

2.5 CONTROL AND MONITORING

A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.

B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.

E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
   1. AC voltmeter (3-phase, line to line and line to neutral values).
   2. AC ammeter (3-phases).
   3. AC frequency meter.
   4. AC kW output (total and for each phase). Display shall indicate power flow direction.
   5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
   6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
   7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
   8. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
   9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
   10. DC voltmeter (alternator battery charging).
   11. Engine-coolant temperature gauge.
   12. Engine lubricating-oil pressure gauge.
   13. Running-time meter.
   14. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.
   15. Fuel tank derangement alarm.
   16. Fuel tank high-level shutdown of fuel supply alarm.
   17. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over load (kW) short circuit, over current, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.
   18. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
   19. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
   20. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
   21. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
   22. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

F. Control Heater: Generator sets that are installed in outdoor enclosures, or are in tropical or coastal environments shall be provided with control heaters for anti-condensation protection.

G. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:
1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.
3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
6. The protective system provided shall not include an instantaneous trip function.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H

D. Temperature Rise: 105 / Class F environment.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.

G. Enclosure: Drip-proof.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Sound Attenuated Aluminum housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

B. Construction:
   1. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents.
   2. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
   3. Exhaust System:
      a. Muffler Location: Within enclosure.
   4. Hardware: All hardware and hinges shall be stainless steel.
   5. Wind Rating: Wind rating shall be 150 mph
   6. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
   7. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
   8. Inlet ducts shall include rain hoods

C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge.
   2. Motorized Louvers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating. Dampers shall be of a “fail open” design to allow airflow in the event of failure

D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 78 dBA measured at any location 23 ft from the engine generator in a free field environment.

E. Electrical Provisions
   1. Compliance with NEC: Package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing.
   2. Provide an internally mounted and wired electrical distribution panel to serve the engine generator and enclosure; including:
      a. 100 amp distribution panelboard connected to a 120/208VAC 3Ø utility service by the installer.
      b. Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure.
      c. Factory wired normal AC service from the panelboard to the engine coolant heater, alternator heater, and battery charger.
      d. Interior Lights with Switch: Two three-way switches controlling three AC lamps mounted in vapor tight and gasketed fixtures
   3. External Electrical Connections: All power and control interconnections shall be made within the perimeter of the enclosure.

F. Site Provisions:
   1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

2.9 VIBRATION ISOLATION DEVICES

A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.
   1. IBC Compliance: Isolators complying with IBC requirements shall be specified in the equipment documentation, as well as the installation requirements for the unit.

2.10 FINISHES

A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer’s standard color or as directed on the drawings.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
   2. Full load run.
   3. Maximum power.
   4. Voltage regulation.
   5. Steady-state governing.
   6. Single-step load pickup.
   7. Simulated safety shutdowns.
   8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.

B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

D. Contractor shall coordinate remote pushbutton location (when required) with engineer prior to installation. Provide allowance for 75’ of conduit and required cabling unless otherwise located on plans.

E. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer’s instructions and seismic requirements of the site.

F. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

G. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

H. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.2 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:

B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.3 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 20 persons. Training date shall be coordinated with the facility owner.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.5 SERVICE AND SUPPORT

A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of $3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be able to respond to a service call within 12 hours of receipt.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

END OF SECTION 26 32 13

SECTION 23 63 00 - AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches
   2. Remote annunciation systems
   3. Bypass/isolation switches

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
   1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
   2. Single Line Diagram: Show connections between transfer switch, power sources and load. Including all bypass connections.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
   1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
   2. Internal electrical wiring and control drawings.
   3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.
   4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.

C. Manufacturer and Supplier Qualification Data
   1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
   2. Manufacturer shall be capable of providing documentation of:
      a. A minimum of 50 documented installations of similar products in service within the United States.
      b. Certification that the manufacturer maintains a service and parts support network capable of providing response within 12 hours.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 78 23 Section "Operation and Maintenance Data," include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.

E. Warranty documents demonstrating compliance with the project’s contract requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.
   1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
   2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.
   3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

B. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.

D. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
   1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
   2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
   3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
   4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
   5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
   6. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
   7. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
   8. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
   9. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
   10. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
   11. IEC 1000-4-6 Conducted Field Immunity
   12. IEC 1000-4-11 Voltage Dip Immunity
   13. IEEE 62.41, AC Voltage Surge Immunity
   14. IEEE 62.45, AC Voltage Surge Testing

E. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.

F. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of five (5) year from the warranty start date. The warranty start date is the date of substantial completion.

G. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 COORDINATION

A. Size and location of concrete bases and anchor bolt inserts shall be coordinated. Concrete, reinforcement and formwork must meet the requirements specified in Division 03.

B. If Project calls for bypass switch(es) mounted on a concrete base, the base must be designed to accommodate the requirements of the drawout mechanism (extension rails and/or wheeled carriage) of the bypass switch.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASCO
2. Trystar (Docking stations & Manual Transfer Switches)

B. Switches manufactured by other manufacturers that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.

C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Provide transfer switches in the number and ratings that are shown on the drawings.

B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.

C. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.

D. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.

5. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
6. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
   a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
7. Transfer switches designated on the drawings as “4-pole” shall be provided with a switched neutral pole switched which is switched simultaneously with phase poles.
8. All transfer switches in this project shall be by-pass isolation.

H. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.

I. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism

J. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.

K. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
2. Exterior cabinet doors shall provide complete protection for the system’s internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.
4. Indoor transfer switches shall be NEMA-1. Outdoor transfer switches shall be NEMA-3R.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Indicated current ratings:
1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
2. Main contacts shall be rated for 600 VAC minimum.
3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).

C. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.

D. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.

E. Neutral Switching: Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched

simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.

F. Automatic Transfer Switch Control Features
1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to Source 2. If Source 1 is available when the load-shed signal is received, the transfer switch shall connect to Source 1.
4. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
5. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.
6. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
7. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
8. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.

G. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.
1. The indicator panel LEDs shall display:
    a. Which source the load is connected to (Source 1 or Source 2)
    b. Which source or sources are available
    c. When switch is not set for automatic operation, the control is disabled
    d. When the switch is in test/exercise mode
2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
    a. Activate pre-programmed test sequence
    b. Override programmed delays, and immediately go to the next operation
    c. Reset the control by clearing any faults
    d. Test all of the LEDs by lighting them simultaneously
3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
    a. AC voltage for all phases, normal and emergency
    b. Source status: connected or not connected.
    c. Load data, including voltage, AC current, frequency, KW, KVA, and power factor.
4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
    a. Set nominal voltage and frequency for the transfer switch
    b. Adjust voltage and frequency sensor operation set points

c. Set up time clock functions
d. Set up load sequence functions
e. Enable or disable control functions including program transition
f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history

H. Control Functions: Functions managed by the control shall include:
1. Software adjustable time delays:
a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
d. Engine cooldown: 0 to 30 minutes (default 10 min)
e. Programmed transition: 0 to 60 seconds (default 3 sec)
2. Voltage imbalance sensing:
a. Dropout: 2 to 10% (default 4%)
b. Pickup: 90% of dropout
c. Time delay: 2.0 to 20 seconds (default 5 sec)
d. Bar graph meter panel, to display 3-phase AC Amps, 3-phase AC Volts, Hz, KW load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.
3. Phase rotation sensing:
a. Time delay: 100 msec
4. Loss of single-phase detection:
a. Time delay: 100 msec

I. Control features shall include:
1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.
2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.
5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.

J. Control Interface
1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
2. The transfer switch shall be provided with a network communication card, and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.
3. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

K. Engine Starting Contacts
1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

2.4 BYPASS/ISOLATION SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Transfer switches that are designated on the drawings as “bypass isolation” transfer switches shall be provided with a manually-operated bypass switch arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

1. The bypass switch shall be enclosed in the same cabinet as the automatic transfer switch, and UL-listed as an assembled product.
2. The bypass isolation switch shall provide a means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load if necessary, and to isolate the transfer switch from both sources for maintenance or repair without a power interruption or disturbance.
    a. Designs that bypass to only one source are not acceptable under this specification.
3. The bypass switch shall be operable without the use of tools, and shall include the ability to isolate the automatic switch mechanism without the use of tools and without opening the exterior cabinet door(s).
4. Operability: Switch shall be constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations, in 15 seconds or less.
5. Bypass isolation switch equipment shall be UL listed per Standard 1008 and CSA approved, with continuous current rating, voltage and frequency ratings, and withstand and closing ratings equal to the transfer switch ratings at the specified conditions of ambient temperature, humidity, and altitude.
6. The bypass isolation and transfer switches shall be mechanically held in each position. Switching mechanisms shall be break-before-make on all poles, including the neutral pole on 4-pole switches except where closed transition transfer is specified as defined in section "CLOSED-TRANSITION TRANSFER SWITCHES". The switch mechanism shall be an over-center toggle device which provides stored energy contact operation during both opening and closing. The speed of contact operation shall be independent of the force applied to the operating handles, which permit manual operation under load.
7. Provide means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks shall prevent transfer-switch operation, except for testing or maintenance.
8. Bypass switch shall be a fully-rated, manually-operated switch, rated for the same loads as the automatic transfer switch. Bypass switch shall provide bypass to either normal or emergency source by use of a door mounted, keyed source selector switch and a permanently mounted external operating handle. Equipment shall provide manual bypass without disturbance of the power supply to the load.
    a. Equipment requiring load isolation before bypass is not acceptable for use on this Project.
9. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
10. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
11. Positive mechanical interlocks shall prevent all possible source-to-source interconnections via the bypass switch. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action.
    a. Designs which depend on electrical interlocks to prevent source to source interconnections, or which intentionally interconnect the sources via the bypass switch, are not acceptable.
12. The equipment shall utilize automatic, mechanical stops to prevent manually bypassing to a dead source.
    a. Equipment that does not prevent dead source bypass is not acceptable.

13. A drawout isolation mechanism shall provide closed-door isolation of the transfer switch. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open before the mechanism will permit isolation of the transfer switch. Drawout arrangement must provide physical separation from live parts and accessibility for testing and maintenance operations.
14. The isolation mechanism shall provide for three-position operation: Connected, Test, and Isolated. In the Connected position, isolation contacts shall be fully engaged and closed, with the transfer switch control cable connected. In the Test position, isolation contacts shall be open and the transfer switch control cable connected. The Test position shall allow operational testing of transfer switchs and controls without power disruption to the load. In the Isolated position, the transfer switch and control shall be completely isolated from all power sources. In the Isolated position, the transfer switch shall be capable of being withdrawn from the cabinet.
15. The bypass and isolation process for the automatic transfer switch shall be capable of being fully accomplished without opening the cabinet door.
16. Interconnection of bypass/isolation switch with automatic transfer switch shall consist of factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.
17. Note the size and access requirements for the transfer switch with bypass isolation and provide equipment that will fit into the space allowed as well as complying with code-specified access requirements.
18. Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.

2.5 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Switch in test mode.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

C. Malfunction of annunciator or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation.

D. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails

2.6 MANUAL TRANSFER SWITCHES (MTS)

A. The transfer switch unit shall be manually operated and mechanically held. The switch shall be mechanically interlocked to ensure only one of three possible positions, Source 1, Source 2, or Center Off Fused disconnect type switches shall not be acceptable.

B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

C. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented blow-on construction for high withstand current capability and be protected by separate arcing contacts.

D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.

E. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

F. Where neutral conductors must be switched, the MTS shall be provided with fully- rated neutral transfer contacts.

G. Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.

H. The MTS shall be tested in accordance with UL 1008 for transfer switches. Switch ratings of 260 amperes and less shall have endurance rating of 6000 cycles, 400 ampere shall have endurance rating of 4000 cycles, and 600 – 1200 ampere shall have endurance rating of 3000 cycles.

I. Operation:
   1. The transfer switch shall be arranged for manually actuated manual operation.
   2. The manual transfer shall be actuated via a mechanical operating mechanism.
   3. The manual operating handle shall be capable of external operation without opening the enclosure door.
   4. It shall have the same contact to contact speed as automatic operation
   5. There shall be three positions for manual operation:
      a. Connected to Source 1 (preferred)
      b. Connected to Source 2 (alternate)
      c. Connect to center off (disconnected position)
   6. Switch position when connected to Source 1, or Source 2 shall be pad - lockable

J. Additional Features:
   1. Mechanical position indicators (yellow) visible to the operator shall be included for Source 1 (preferred), Source 2, (alternate), and Center Off (disconnected).
   2. LED indicators for Source 1 (preferred), and Source 2 (alternate).
   3. Auxiliary position indicating contacts, rated 10 amps, 250 Vac shall be provided consisting of one closed when the MTS is connected to Source 1 (preferred), and one contact closed when the MTS is connected to Source 2 (alternate)
   4. A form A contact shall be provided to indicate switch is in the Center Off (disconnected) position.
   5. Auxiliary Contacts: Position indicating contacts, rated 10 amps, 250 Vac shall be provided consisting of two closed when the MTS is connected to Source 1 (preferred), and two contact closed when the MTS is connected to Source 2 (alternate).
   6. Integrated Quick Connects: contains quick connects which provide a connecting means for connecting a portable generator.
      a. Quick connects shall be located on Source 2 (emergency):
         i. For 400A and below models, there shall be one (1) row of up to five (5) series single pole connections.
         ii. For 600A - 800A models, there shall be two (2) rows of up to five (5) single pole connections.
         iii. For 1000A-1200A models, there shall be three (3) rows of up to 5 single pole connections.

b. All electrical connections shall be 16 cam type single pole connectors, available color coded as per industry standard practice.

K. Withstand and Closing Ratings:

1. The MTS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the MTS terminals with the type of overcurrent protection shown on the plans. WCR MTS ratings @ 480v shall be as follows when used with specific circuit breakers or current limiting fuses:

MTS Ampacity	Withstand & Closing Rating MCCB	W/CLF
150-600	50,000A	200,000
800-1200	65,000A	200,000

PART 3 EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:
   a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

B. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to 26 05 53 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems." Refer to drawings for details.

E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.

B. Manufacturer's representative shall perform tests and inspections and prepare test reports.

C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
   1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
   2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Verify time-delay settings.
      c. Verify that the transfer switch is accurately metering AC voltage and current.
      d. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

3.4 DEMONSTRATION

A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
   1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.
   2. The class duration shall be at least 4 hours in length, and include practical operation with the installed equipment.

END OF SECTION 23 36 00

SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

A. This Section specifies the lightning protection system for the building(s) or structure(s). This system provides safety for the building and occupants by preventing damage to the structure caused by lightning. The design of this system is to be in strict accordance with this section of the specification and all contract drawings that apply.

B. The work covered under this section of the specifications consists of furnishing labor, materials and services required for the completion of a functional and unobtrusive lightning protection system.

C. A firm actively engaged in the installation of certified lightning protection systems and listed with Underwriters' Laboratories, Inc. and the Lightning Protection Institute shall install the system.

1.2 STANDARDS

A. The entire lightning protection system shall be designed and installed in accordance with:
1. National Fire Protection Assoc. (NFPA) Document # 780
2. Underwriters' Laboratories, Inc. (UL) Standard # 96A
3. Lightning Protection Institute (LPI) Standard # 175
4. National Electrical Code (NEC)

1.3 SYSTEM DESIGN

A. The work covered under this section of the specifications consists of furnishing labor, materials and services required for the completion of a functional and inconspicuous lightning protection system approved by the Architect and Owner. The design of this system is to be in strict accordance with this section of the specifications and all contract drawings that apply.

B. If any departure from the contract drawings or submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practical to the architect and engineer for approval.

1.4 QUALITY ASSURANCE

A. The contractor shall furnish a UL Master Label or Letter of Findings upon completion of the installation.

B. The system installation shall be made under the supervision of an LPI Certified Master Installer, and the LPI System Certification shall be delivered upon completion of the installation.

C. The installation shall comply with the requirements of NFPA 780, UL 96A, and LPI 175.

D. The installing lightning protection contractor company shall be listed with the Lightning Protection Institute, and Underwriters' Laboratories, Inc. The installation contractor shall have personnel on staff Certified by the LPI as a Master Installer or Master Designer of lightning protection systems.

E. LPI qualified staff shall provide supervision of the installation to the Standards.

1.5 SUBMITTALS

A. Specification Compliance Review: Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

B. Complete design submittal drawings showing the type, size, and location of all grounding, roof conductors, down conductors, through-roof connectors and air terminals, and shop drawings shall be submitted to the architect and engineer for approval prior to the commencement of work.
   1. Product Data: Provide dimensions and materials of each component, and include indication of listing in accordance with UL 96 and LPI 175 standards.
   2. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
   3. Submit certificate of compliance from Underwriters' Laboratories and Lightning Protection Institute indicating approval of lightning protection systems.
   4. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation.
   5. A complete shop drawing shall be submitted to the architect and engineer for review prior to commencement of the installation. The shop drawing shall show the extent of the system layout designed for the structure along with details of the products to be used in the installation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Only firms regularly engaged in the manufacture of lightning protection system components whose products have been in satisfactory use in similar service shall be used.
   1. Beijing Arrow Advanced Technology Co., Ltd.
   2. East Coast Lightning Equipment, Inc.
   3. ERICO, Inc.
   4. Harger, Inc.
   5. Heary Brothers Lightning Protection Co., Inc.
   6. Independent Protection Company, Inc.
   7. Preferred Lightning Protection
   8. Robbins Lightning, Inc.
   9. Thompson Lightning Protection, Inc.
   10. Cooper Power Systems
   11. Bonded Lighting Protection

2.2 PRODUCTS

A. All materials shall comply in weight, size, and composition with the requirements of the UL 96 Materials Standards. All equipment shall be UL listed and properly labeled. The system furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection equipment and a member of LPI.

B. Equipment shall be the manufacturer's latest approved design of construction to suit the application where it is to be used in accordance with accepted industry standards and with NFPA, LPI, & UL requirements.

2.3 MATERIALS

A. Class I materials shall be used for systems on structures not exceeding 75 feet in height and Class II materials shall be used for systems on structures exceeding 75 feet above grade.

B. Copper shall be of the grade ordinarily required for commercial electrical work, generally designated as being 95 percent conductive when annealed. Aluminum conductors shall be of electrical grade aluminum alloy.

C. Lightning protection materials shall be coordinated with building construction materials to assure compatibility. Aluminum lightning protection materials shall not be embedded in concrete or masonry, installed on or below copper surfaces, or used for the in-ground system. Copper lightning protection materials shall not be installed on aluminum surfaces. Copper system components within 2 feet of chimney exhausts shall be tin coated to protect against deterioration.

D. Strike termination devices shall be provided to place the entire structure under a zone of protection as defined by the Standards. Air terminals shall project a minimum of 10 inches above protected areas or objects. Air terminals shall be located within 2 feet of exposed corners and roof edges.

E. Metallic bodies having a thickness 3/16” or greater may serve as strike termination devices without the addition of air terminals. These bodies shall be made a part of the lightning protection system by connection(s) according to the Standards using main size conductors and bonding fittings with 3 square inches of surface contact area.

F. Cable conductors shall provide a two-way path from strike termination devices horizontally and downward to connections with the ground system. Cable conductors shall be free of excessive splices and sharp bends. No bend of a conductor shall form a final included angle of less than 90 degrees nor have a radius of bend less than 8 inches. Structural elements and design features shall be used whenever possible to minimize the visual impact of exposed conductors.

G. Cable down conductors shall be concealed within the building construction. At existing structures, cable down conductors may be enclosed within PVC conduit from roof to grade level and exact locations shall be coordinated with the Architect to minimize visual impact of exposed down conductors. Down conductors shall be spaced at intervals averaging not more than 100 feet around the protected perimeter of the structure. In no case shall any structure have fewer than two down conductors. Where down conductors are exposed to environmental hazards at grade level, schedule 80 PVC conduit shall be used to protect the conductor to a point eight feet above grade.

H. In the case of structural steel frame construction, cable down conductors shall be omitted and roof conductors shall be connected to the structural steel frame at intervals averaging not more than 100 feet around the protected perimeter of the structure.

I. Exposed cable conductors shall be secured to the structure at intervals not exceeding 3 feet – 0 inches. Fasteners, nails, screws, or bolts shall be of suitable configuration for the intended application and of the same material as the conductor or of electrolytically compatible materials. Galvanized or plated steels are not acceptable.

J. Connectors and splicers shall be of suitable configuration and type for the intended application and of the same material as the conductors or of electrolytically compatible materials.

K. Ground terminations suitable for the soil conditions shall be provided for each downlead conductor. Where the structural steel framework is utilized as main conductors for the

system, perimeter columns shall be connected to the grounding system at intervals averaging 60 feet or less on the protected perimeter. For any structure in excess of 60 ft. in vertical elevation above grade, a ground loop interconnecting all ground terminals and other building grounded systems shall be provided. Refer to the electrical grounding specifications for additional information.

PART 3 EXECUTION

3.1 INSTALLATION

A. The installation of the lightning protection system components shall be performed in a neat and workmanlike manner.

B. Roof penetrations required for down conductors or for connections to structural steel framework shall be made using through-roof assemblies with solid bars and appropriate roof flashings. The roofing contractor shall furnish the methods and materials required at roofing penetrations of the lightning protection components and any additional roofing materials or preparations required by the roofing manufacturer for lightning conductor runs to assure compatibility with the warranty for the roof. The roofing contractor shall be responsible for sealing and flashing all lightning protection roof penetrations as per the roof manufacturer's recommendations. Refer to the roofing specifications for the lightning protection roof penetrations and/or method of conductor attachment.

C. LPI certification requires a signature by a representative of the owner at three stages of installation – the in-ground system, the concealed portion of the work, and the exposed or roof level section. UL certification requires inspection by their third-party field staff after completion of the installation. Upon completion of the lightning protection installation, the installing contractor shall provide to the Owner an as-built drawing of the system, along with copies of the UL and LPI Certificates of completion.

END OF SECTION 26 41 13

SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. I-nominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, I nominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.
   3. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor can survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable. In house testing will not be accepted.
   4. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

C. Testing: Third Party Independent Testing

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: The SPD system shall have a limited product warranty when installed in compliance with applicable national/local electrical codes and manufacturer’s installation manual.
   1. Warranty Period: Twenty (20) years from date of Substantial Completion. TYPE “C”
   2. Warranty Period: Fifteen (15) years from date of Substantial Completion. TYPE “A” &”B”

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage. MCOV shall be a tested value per section 37.7.3 of UL1449 4th Edition.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPRESSOR (TYPE C)

A. Basis of Design: Subject to compliance with requirements. Provide comparable product to the following:
   1. Current Technology “SL3” Series.
   2. Approved equivalent provided all specification requirements met within. Submission package must be received by engineer two weeks prior to bid date shall fully comply with all performance characteristics included in this specification.

B. SPDs: Listed as Type 1 SPD per UL1449 4th Edition
   1. SPDs with the following features and accessories:
      a. Integral disconnect switch (where breaker not provided).
      b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

c. Indicator light display for protection status.
d. Form-C contacts: one normally open and one normally closed, for remote monitoring of protection status, and Advanced monitoring with status, surge counter and history log of events.

C. Comply with UL 1283 with a maximum attenuation of 54dB based on 50ohm insertion loss test per MIL-STD-220B

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 200 kA (400kA per phase). The peak surge current rating shall NOT be the arithmetic sum of the ratings of the individual MOVs in a given mode. SPD manufacturer shall provide independent 3rd party testing validating unit is capable of surviving a single surge at the specified rating or up to and not to exceed 200,000 kA.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277V or 208Y/120V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
2. Line to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
3. Line to Line: [1800 V for 480Y/277 V] [1200 V for 208Y/120 V].

F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
2. Line to Ground: [700 V] [1000 V].
3. Line to Line: 1200 V.

G. SCCR: Equal or exceed 200 kA.

H. I nominal Rating: 20 kA and compliance to all UL96A requirements for ac surge protection.

I. Repetitive Surge: SPD shall survive a minimum of 14,000 repetitive category C3(20kV/10kVA) surges with no more than 10% deterioration. Calculated repetitive surge values will not be accepted. SPD manufacturer shall provide repetitive surge test report.

J. Temporary Over Voltages: SPD shall be able to prevent common temporary over voltage from damaging the MOVs, increasing longevity and ability of SPD unit to protect the critical load. SPD shall limit the voltage per the following chart.

Overvoltage seen by MOVs as % of Nominal				
	available current			
time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

K. Temporary Over Voltage: SPD shall be able to withstand a minimum of 100 temporary over voltage events, as defined by: 30A available fault current, 30 cycles of duration, with 10 seconds between events.

2.3 PANEL SUPPRESSORS (Type B and A)

A. Basis of Design: Subject to compliance with requirements. Provide comparable product by the following:

1. Current Technology “TG3”.
2. ASCO 570 SERIES
3. Approved equivalent provided all specification requirements met within. Submission package must be received by engineer two weeks prior to bid date shall fully comply with all performance characteristics included in this specification.

B. SPDs: Listed as Type 1 SPD per UL1449 4th Edition
1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 2 to 5A and 24-V ac to 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 100kA (Type B), 200kA per Phase and 50kA (Type C) 100kA per Phase. The peak surge current rating shall NOT be the arithmetic sum of the ratings of the individual MOVs in a given mode. SPD manufacturer shall provide independent 3rd party testing validating unit is capable of surviving a single surge at the specified rating.

D. Comply with UL 1283 with a maximum attenuation of 34dB based on 50ohm insertion loss test per MIL-STD-220B

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277V or 208Y/120V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
2. Line to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
3. Neutral to Ground: [1000 V for 480Y/277 V] [700 V for 208Y/120 V].
4. Line to Line: [2000 V for 480Y/277 V] [1200 V for 208Y/120 V]

F. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

G. SCCR: Equal or exceed 200 kA.

H. Inominal Rating: 20 kA

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: SPD SHALL be equipped with mechanical lugs that can accept up to #2 AWG wire. Where conductors between SPD and switchgear exceed 10’ in total length, they shall be “High Performance Interconnect” (HPI) cables with Ultra Low impedance characteristics at 10kHz and above.

B. Class 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground. If installed lead length exceeds 10', SPD manufacturer shall provide a low impedance cable that improves the installed performance.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:
1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Contractor shall perform the following tests and inspections with the assistance of a factory-authorized service representative.
1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 SYSTEM TESTING

A. Upon completion of installation, provide the start-up and testing services of a factory-authorized and factory-trained local service representative. The tests shall include:
1. Off-line Testing: Impulse injection to verify the system tolerances as well as verification of proper facility neutral-to-ground bond. Compare field test results to factory benchmark test parameters supplied with each individual unit.

2. On-line Testing: Verify that suppression and filtering paths are operating with 100% protection as well as verification of proper facility neutral-to-ground bond by measuring neutral-to-ground current and voltage and by visual inspection.
3. Voltage measurements from Line-to-Ground (L-G), Line-to-Neutral (L-N), Line-to-Line (L-L), and Neutral-to-Ground (N-G), taken at the time of the testing procedure.

3.4 DOCUMENTATION AND REPORTING

A. Record results of field testing and compare to factory benchmark test parameters supplied with each individual surge protective device. Indicate that the integrity of neutral-to-ground bonds were verified through testing and visual inspection, and that grounding bonds were observed to be in place.

B. Submit to the Owner's representative and to the Architect/Engineer copies of the startup test results and the factory benchmark testing results for confirmation of proper suppression filter system function, as required by this section. Provide the number of copies as required by Division One and the Electrical General Provisions section; and three copies where not otherwise specified.

END OF SECTION 26 43 13

SECTION 26 50 00 - LIGHTING

PART 1 GENERAL

1.1 LIGHTING SCHEDULE

A. The Contractor shall install lighting fixtures and accessories as shown on the drawings and/or described herein. The Contractor shall also install lamps for all fixtures.

1.2 SUBMITTALS & PRIOR APPROVAL

A. Prior approvals and/or submittals shall submit the following:
   1. Cutsheets clearly indicating fixture options selected.
   2. Photometric calculations of the floor plan including point by point calculations and a calculation schedule which shall include the following foot-candle measurements for each room and site plan.
      a. Maximum value
      b. Minimum value
      c. Max/Min Ratio
      d. Average

PART 2 PRODUCTS

2.1 LED LIGHTING

A. Lighting fixtures with LED light sources shall meet the following fixture and light source requirements:
   1. LED Color Temperature – Refer to plans
   2. Line Voltage – Universal Voltage 120-277 volts
   4. Expected Lamp Life – Minimum L70 ≥ 60,000 hours at 25°C per LM-80 data.
   5. Driver – Components must be fully encased in potting material for moisture resistance, and must comply with IEC and FCC standards
   6. Surge Protection – Surge protection must be provided including separate sure protection built into electronic driver
   7. Mechanical – Luminaire LED system components to be low copper aluminum, with high performance heat sink(s) designed specifically for LED luminaires. No active cooling features (Fans, etc.). Luminaire configuration must allow for modular upgradability and/or field repair of all electrical components (i.e. LED modules, Driver(s), etc.). Drivers and vertical light bars must be all mounted to a twist-lock tool-less assembly for ease of installation and trouble- shooting.
   8. CRI – Minimum of 80CRI

2.2 LIGHTING ACCESSORIES

A. All lighting shall be equipped with the appropriate housing for the ceiling type shown on the architectural reflected ceiling plan.

   1. GYP Ceilings –
      a. 1’X4’ 2’X2’ & 2’X4’ Troffers: Provide flange kit or surface mount kit. If not explicitly indicated on plan contractor shall price based on the more costly product and submit an RFI to Engineer prior to purchase.
      b. Downlights: Provide recessed housing and appropriate flange kit.
      c. Strip lighting: Provide surface mount kit. In areas with ceiling heights greater than 10’ contractor shall provide chain suspension hardware.
      d. Architectural linear fixtures: Where indicated as recessed contractor shall provide flange kit or mud-in kit as required. If not explicitly indicated on plan contractor shall price based on the more costly product and submit an RFI to Engineer prior

to purchase.

2. Grid Ceilings – Provide appropriate mounting hardware to recess fixtures into grid.

B. Fire ratings: Lighting in fire rated ceiling shall be equipped with fire padding, caulking, and/or housings as required to maintain fire ratings. Contractor shall refer to architectural plans for all fire ratings prior to bid.

C. Emergency battery backup and inverters:
1. Where remote battery backup is utilize contractor shall coordinate all remote test switch locations with owner/architect prior to rough in. They shall not be located in ceiling adjacent to fixture.
2. Where integral battery backup is utilized the fixture shall include self-diagnostics. This shall not be required if specified fixture does not include a self-diagnostic option.
3. Provide UL924 transfer devices as required to provide emergency power to all fixtures on life safety branch.

2.3 FIXTURES

A. Fixtures as described in the Fixture Schedule on the drawings shall be furnished by the Contractor and shall be properly installed.

B. Where fixtures are specified with emergency remote test switches contractor shall coordinate location of remote test switch with Owner/Architect prior to installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Unless otherwise specified, lighting fixtures shall be permanently installed and connected to the wiring system.

B. The Contractor shall support each fixture, independently from the building structure. Ceiling framing members shall not be used to support fixtures except in specified areas where ceiling supports for this purpose have been specified elsewhere in these specifications. Each fixture shall have at least two fixture supports.

C. Flexible conduit used for fixture whips shall be at least twelve (12) inches, but not more than 48 inches long.

D. Site lighting poles shall include a foundation with a minimum depth below grade of 8’. Those located within parking areas shall extend from grade 3’ in pedestrian areas a reduction in foundation height is permitted, refer to foundation drawings for specific pedestrian area requirements.

3.2 CEILING COMPATIBILITY

A. Catalog numbers shown on the drawings or descriptions of lighting fixtures contained herein may indicate fixture compatibility with certain types of ceiling construction. Contractor shall determine exact type of ceiling actually to be furnished in each area and shall obtain fixtures to suit, deviation from specified catalogue numbers or descriptions only where necessary and only to the extent necessary to insure fixture/ceiling compatibility.

3.3 LIGHT LEAKS

A. The Contractor shall, at the end of this project, adjust all recessed lighting fixtures so that

there will be no light leaks between the fixture trim and the ceiling. Contractor shall also adjust recessed fluorescent fixtures to eliminate any light leaks between fixture trim and ceiling grid member.

3.4 LAMPS

A. The Contractor shall install lamps in all fixtures and shall obtain replacement lamps should any not properly operate or become damaged during construction.

3.5 EXIT FIXTURES

A. Exit fixtures shall be installed according to Life Safety Code requirements, with face(s) plainly visible and directional arrows indicating the proper direction of egress.

END OF SECTION 26 50 00

DIVISION

27

COMMUNICATIONS

SECTION 27 00 00 – STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 PURPOSE

A. This document defines the products and the execution requirements required to furnish and install a complete distribution system utilizing a structured cabling system.

B. All cables and related terminations, support and grounding hardware shall be furnished, installed, tested, and documented by the structured cabling contractor as detailed in this document.

C. The distribution system shall be all inclusive and represent a complete installation at the sites shown on the attached drawings and in the attached specifications. The Vendor shall be responsible for all parts, labor, and all other associated apparatus necessary to completely install, test and turnover for acceptance to the Customer the cabling system detailed herein.

D. Product specifications and general design considerations are provided in this document. Quantities of telecommunication outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

E. Refer to contract drawings for additional requirements to include color coding of faceplates, jacks and cables, labeling, installation, etc.

1.3 RELATED REQUIREMENTS

A. Drawings and general provision of Contract, including General and Supplementary Conditions, Division 1 Specification, and Electrical sections apply to work in this section.

B. Install raceways for auxiliary systems.

C. Interior conduit EMT, minimum 1” unless noted otherwise.

D. Conduit to extend from wall and floor outlets to above accessible ceiling and terminate with a bushing.

E. All conduits indicated as spare shall have nylon pullcord.

1.4 REFERENCE STANDARDS

A. ANSI/TIA/EIA-568B.1-Commercial building Telecommunications Cabling Standard, Part 1: General Requirements

B .ANSI/TIA/EIA-568-B.2-Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

C. ANSI/TIA/EIA-568-B.3- Optical Fiber Cabling Components Standard.

D. ANSI/TIA/EIA-569B-Commercial Building Standard for Telecommunications Pathways and spaces.

E. ANSI/TIA/EIA-606(A)-The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

F. ANSI-J-STD-607(A)- Commercial Building Grounding and Bonding Requirements for Telecommunications.

G. TIA-526-7-OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.

I. ANSI/TIA/EIA-758(A)- Customer-Owned Outside Plant Telecommunications Cabling Standard.

J. TIA TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical

K. ANSI/TIA/EIA 568 B-2.10- 10GIG ETHERNET

L. Install Cabling in accordance with the most recent edition of BICSI publications.
1. BICSI-Telecommunications Distribution Methods Manual.
2. BICSI-Installation Transport Systems information Manual.
3. BICSI-Network Design Reference Design Manual.
4. BICSI-Outside Plant Design Reference Manual.

M. Federal, State and local codes, rules, regulations, and ordinances governing the work, are fully part of the specifications as if herein repeated or hereto attached.

N. If the contractor should note items in the drawings or the specifications, construction of which would be a code violation, promptly call them to the attention of the owner's representative in writing.

O. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

P. All material shall be listed by UL or other National Independent testing standard shall apply.

Q. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All construction documents listed are believed to be the most current. The Vendor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

R. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

1.5 APPROVED CONTRACTOR

A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated telecommunication systems.

B. The installation of all cable, equipment, terminations, & associated services shall be performed by a company that is a Manufacture’s Certified Structured Cabling System Installer in good standing with a minimum of three (3) years of experience on similar systems.

C. A copy of certification documents must be submitted with the product submittals for quote to

be valid. The telecommunications contractor is responsible for workmanship and installation practices in accordance with the manufacturer's written policies.

D. The cable or connectivity manufacturer will extend a 25-year manufacturer's warranty for all products installed in this project to the end user once the telecommunications contractor fulfills all requirements under these specifications.

E. The contractor must have an office with qualified service and installation personnel within 100 miles of the project site.

F. The Telecommunications cabling contractor must provide a reference list with contact names and phone numbers for three (3) projects of similar scope.

G. The contractor shall employ a full-time RCDD to perform the role of Project Manager. RCDD shall be available for consultation and to attend project meetings. The contractor shall not subcontract a third party RCDD.

H. A BICSI certified installer shall be employed by the contractor and be on site as the installation manager.

I. The owner reserves the right to require the Vendor to remove from the project any such employee the Owner deems to be incompetent, careless or insubordinate.

J. All clean up activity related to work performed, will be the responsibility of the Contractor and must be completed daily before leaving he site.

1.6 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate telecommunications work with that of other Sections as required ensuring that the entire telecommunications work will be carried out in an orderly, complete and coordinated fashion.

1.7 SUBMITTALS

A. Submit to the engineer/designer shop drawings, product data (including cut sheets and catalog information), and samples required by the contract documents. Submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the work or in the activities of other contractors. The engineer/designer will indicate approval of shop drawings, product data, and samples submitted to the engineer by stamping submittals "APPROVED" with a stamp. Submitted shop drawings shall be initialed or signed by the contractor's legitimate firm name.
   1. By submitting shop drawings, product data, and samples, the Vendor represents that he/she carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the Vendor has checked, coordinated, and verified that information contained within shop drawings, product data, and samples conform to the requirements of the work and of the contract documents.
   2. The engineer's/designer's approval of shop drawings, product data, and samples submitted by the Vendor shall not relieve the Vendor of responsibility for deviations from requirements of the contract documents, unless the Vendor has specifically informed the engineer/designer in writing of such deviation at time of submittal, and the engineer/designer has given written approval of the specific deviation. The vendor shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the Vendor in writing, and specifically approved by the engineer in writing.
   3. The engineer's/designer's approval of shop drawings, product data, and samples shall not relieve the Vendor of responsibility for errors or omissions in such shop drawings,

product data, and samples.
4. Storage and handling requirements and recommendations.
5. Installation method.

B. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

C. Submit proof from manufacturer that the contractor is in good standing with the manufacturer's warranty program.

D. Submit letter from manufacturer stating that the manufacturer will provide twenty-five (25) year warranty in accordance with the requirements stated in this document.

E. Submit copy of RCDD certification.

F. Upon request by the engineer/designer, furnish a list of references with specific information regarding type of project and involvement in providing of equipment and systems.

G. Submit references as required.

H., At completion of project, Contractor shall submit the following:
1. Horizontal certification test results printed and saved to USB drive.
2. Backbone certification test results printed and saved to USB drive.
3. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD). The record documents shall be bound and consist of the following:
   a. Product cut sheets for all products supplied.
   b. Test reports for horizontal cabling.
   c. Test reports for backbone cabling.
   d. Manufactures warranties.
   e. "D-Size" As built drawings.

I. As built drawings should accurately record location of service entrance conduit, termination backboards, outlets boxes, cable raceways, cable trays, pull boxes, and equipment racks electronically using AutoCAD 2000 or later version and on minimum "D" size reproducible paper prints.

J. The contractor shall prepare an 18" x 24" as-built serving zone drawing for each Telecommunication Room. The drawing shall be laminated, framed and secured to the wall in the Telecom Room.

K. Work shall not proceed without the Engineer's approval of the submitted items. The Contractor shall receive approval from the Engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the engineer.

1.8 QUALITY ASSURANCE

A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one (1) year from the date of manufacture), unused and without blemish or defect.

B. Equipment and materials of the type for which are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.

C. Material and equipment shall be new, and conform to grade, quality, and standards

specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout installation.

D. Product Requirements:
   1. The product shall be manufactured by an ISO 9001-2000 Certified Facility.
   2. Product shall be free from defects in material and workmanship.
   3. The manufacturer must have a field representative who holds an RCDD who will perform quality control inspections monthly, during the life of the project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Products must be stored according to manufacturers' recommendations.

B. Keep stored products clean and dry.

C. If the Telecommunications Contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the owner.

1.10 DRAWINGS

A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the Telecommunications Contractor in bidding for the job. The Telecommunications Contractor shall make allowance in bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The Telecommunications Contractor shall verify all dimensions at the site and be responsible for their accuracy.

C. Prior to submitting the bid, the telecommunications Contractor shall call the attention of the Engineer to any materials or apparatus the Telecommunication Contractor believes to be inadequate and to any necessary items of work omitted.

1.11 WARRANTY

A. See Section "Closeout Submittals" for additional warranty requirements.

B. The Contractor shall provide a manufactures warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include all Horizontal drops and Backbone fiber optic cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of 25 years.

C. Materials and workmanship hereinafter specified shall be fully guaranteed by the vendor for a (1) one year period after Date of Substantial Completion against any defects. Defects which may occur as the result of faulty materials or workmanship within one year after installation and acceptance by The Customer shall be corrected by the Vendor at no additional cost to the Customer. The Vendor shall promptly, at no cost to The Customer, correct re-perform (including modifications or additions as necessary) any nonconforming or defective work within one year after completion of the project of which the work is part.

1.12 SEPARATION FROM EMI SOURCES

A. Comply with BICSI TDMM and ANSI/TIA/EIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

B. Separation between open communications cables or cables in nonmetallic raceways and

unshielded power conductors and electrical equipment shall be as follows:
1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3. Electrical Equipment Rating More than 5 kVA: A minimum of 12 inches.

C. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows.
1. Electrical Equipment Rating Less than 2 kVA: A minimum of 2 ½ inches.
2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
3. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

D. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
1. Electrical Equipment Rating Less than 2 kVA: No requirement.
2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
3. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

E. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

F. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 12 inches.

PART 2 - PRODUCTS

2.1 EQUIVALENT PRODUCTS

A. Due to the nature and type of communications all products, including but not limited to racks, patch panels, jacks, faceplates, patch cords, J-hooks shall be manufactured by Hubbell, Siemon, or Panduit.

B. Provide products of manufacturers as named in individual articles.

C. Where no manufacturer is specified, provide products of manufacturers in compliance with requirements.

D. Where equipment is identified by manufacturer and catalog number, it shall be a base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Contractor may submit for approval, similar equipment of other manufactures as substitution. The Engineer’s decision as to whether the submitted equipment is acceptable shall be final and binding.

E. The request for substitutions must be received (10) ten days prior to bid opening by Engineer in writing, listing all physical and technical differences between product specified and product request for substitution. Product samples of each item must accompany written request.

F. Accepted substitutions will be approved by means of addendum.

G. All fiber shall be single mode.

2.2 CATEGORY 6 HORIZONTAL DISTRIBUTION CABLE

A. All Horizontal station cables shall terminate on modular patch panels in their respective Telecommunication Room or Equipment Room as specified on the drawings.

B. All cable, workstation jack modules and patch panel jack modules shall be the same color as

designated on prints. If colors are not designated Coordinate color with Engineer. See details.

C. Unshielded Twisted-Pair Cabling:
1. Cable construction shall be 23 AWG with four twisted pairs of insulated solid bare annealed copper conductors with separator.
2. Outer jacket shall meet NEC requirements and have a Nominal Cable diameter not to exceed .200 for CMP (in)
3. Cable shall have a minimum bend radius of 1.0 (in).
4. Contain “Crossweb” Filler
5. Must have positive PSACR beyond 250 MHz.
6. Application assurance warranty.
7. All transmission performance parameters shall be independently verified by UL or ETL third party testing organization.
8. Contractor will use a plenum rated cable jacket unless being installed in slab and below grade.
9. Approved Manufacturer - Category 6 Horizontal Cable:

Manufacturer	CMR	CMP
Hubbell	HC6RRx	HC6RPx
Siemon	9C6R4-E4-(XX)-RBA	9C6P4-E4-(XX)-RBA
Panduit	PUR6504xx-UY	PUP6504xx-UY

D. ANY CABLE LOCATED IN SLAB BELOW GRADE SHALL BE RATED FOR WET LOCATIONS.
1. Approved Manufacturer - Indoor/Outdoor Rated Cable:

Manufacturer	CMP
Hubbell	C6IOSPBK
Siemon	9U6W4-A5-12-R1A
Panduit	PUO6AS04BL-G

2.3 CATEGORY 6A HORIZONTAL DISTRIBUTION CABLE

A. All Horizontal WAP Cable shall terminate on modular patch panels in their respective Telecommunication Room or Equipment Room as specified on the drawings.

B. All cable and patch panel jack modules shall be the same color as designated on prints. If colors are not designated Coordinate color with Engineer. See details.

C. Unshielded Twisted-Pair Cabling:
1. Cable construction shall be 23 AWG with four twisted pairs of insulated solid bare annealed copper conductors with separator.
2. Outer jacket shall meet NEC requirements and have a reduced diameter not to exceed .265 for CMP (in)
3. Cable shall have a minimum bend radius of 1.0 (in).
4. Contain “Crossweb” filler.
5. +7dB of Headroom Above Standards to suppress Alien Crosstalk
6. High Power PoE (4PPoE) Read
7. All transmission performance parameters shall be independently verified by UL or ETL third party testing organization.
8. Approved Manufacturer - Category 6A Horizontal Cable:

Manufacturer	CMR	CMP

Hubbell	C6ASRDSY	C6ASPDSY
Siemon	9C6R4-A5-05AR1A	9C6P4-A5-05AR1A
Panduit	PUR6AV04YL-G	PUP6AV04YL-G

2.4 WORK AREA OUTLETS

A. WAO shall consist of a single gang 2 Port or 4 Port thermoplastic face plate.

B. Work area outlets shall each be terminated at their designated work area location in the connector types described below.

C. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Telecommunications Contractor shall submit the proposed configuration for each outlet assembly, with labeling, for review by the owner.

D. The wiring scheme for this project shall be T568B unless otherwise directed by the owner.

E. Category 6 Modular Jack:
1. Third Party Verified Category 6 Component
2. Cobra-Lock Termination Technology
3. Wires Secured Under Constant Compression
4. Easily Re-Terminate
5. 25 IDC Re-termination Cycles
6. Qualified to 150% of 802.3bt PoE Current Level
7. Where color is not indicated coordinate with Engineer prior to installation.
8. Approved Manufacturer - Category 6 Modular Jack (WAO):

Manufacturer	Modular Jack
Hubbell	HJU6xx
Siemon	U6-K0xx
Panduit	CJ688TGxx

F. Jacks at WAO and patch panels shall be color-coded with appropriate colored jacks or icons as follows:
1. Two port face plates:
   a. The left jack shall be BLUE, and the right jack RED. Contractor shall be responsible for making sure the color at the patch panel coordinates with jack at WAO.
2. Four port face plates:
   a. The upper left jack shall be BLUE, the upper right.
   jack shall be RED, the bottom-left jack shall be GREEN, and the bottom right jack shall be GRAY.

2.5 WIRELESS ACCESS POINT OUTLET

A. WAP outlets shall consist of a minimum of two (2) Category 6A cables be terminated above ceiling using a Cat6A Yellow jack in a 2-port Surface Box or using a Cat6A MPTL assembly. Either option shall leave a 10-foot service loop on the horizontal cable run.

B. Each WAP location shall be identified with a 1”x 2” black phenolic tag with white lettering affixed to the underside of the ceiling grid. It shall be the contractor’s responsibility to verify measurements of the ceiling grid prior to ordering the phenolic tags, so as not to create an overhang by the label.

C. Each cable shall be identified with a printed wire wrap label.

D. The wiring pattern for this project shall be T568B unless otherwise directed by the owner.

E. The wiring pattern of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Telecommunications Contractor shall submit the proposed configuration for each outlet assembly, with labeling, for review by the owner.

F. Category 6A Modular Jack:
1. Third Party Verified Category 6 Component
2. Cobra-Lock Termination Technology
3. Wires Secured Under Constant Compression
4. Easily Re-Terminate
5. 25 IDC Re-termination Cycles
6. Qualified to 150% of 802.3bt PoE Current Level
7. Where jack color is not indicated coordinate with Engineer prior to installation.
   a. Approved Manufacturer - Category 6A Modular Jack Assembly (WAP):

Manufacturer	Jack	Surface Box
Hubbell	HJU6AY	HSB2W(P)
Siemon	U6A-K05	MX-SMZ2-02
Panduit	CJ688TGYL	CBX2IW-AY

   b. Approved Manufacturer - Category 6A Modular Plug (WAP):

Manufacturer	Modular Plug
Hubbell	SCP6A
Siemon	ZP1-6AS-01S
Panduit	FP6X88MTG

2.6 COPPER PATCH CABLES

A. Patch Cables shall be factory terminated with modular plugs featuring a tangle-free latch design and clear strain-relief boots to support easy moves, adds and changes. Each patch cord shall be 100% performance tested at the factory to the TIA/EIA Category 6 standard. *Each patch cord shall be made by the same factory as the Cat6 jacks and patch panels used in the project*.

B. Contractor shall provide one 5ft patch cable for each cable terminated at patch panel. Contractor shall provide one patch cable for each terminated WAO, with half the WAO patch cables being 10ft and remaining half being 15ft. Provide an additional 5% surplus equally divided between 5ft, 10ft & 15ft. Confirm lengths and color with owner prior to ordering and transmittal.

C. Approved Manufacturer - Patch Cable:

Manufacturer	5ft Cat6	10ft Cat6	15ft Cat6
Hubbell	HCL6x05	HCL6x10	HCL6x15
Siemon	MC6-05-xx-28	MC6-10-xx-28	MC6-15-xx-28
Panduit	UTP28SP5xx	UTP28SP10xx	UTP28SP15xx

Manufacturer	5ft Cat6A	10ft Cat6A	15ft Cat6
Hubbell	HCL6x01	HCL6x07	HCL6Ax01
Siemon	SP6A-05-xx	SP6A-10-xx	SP6A-15-xx
Panduit	UTP28X5xx	UTP28X10xx	UTP28X15xx

2.7 MODULAR PATCH PANELS

A. All horizontal voice, data and wireless, CCTV & AV cables shall be installed in a modular rack mount patch panel. Each patch panel shall have strain relief bars for each row of 24 ports (a 48-port panel gets 2 relief bars).

B. Approved Manufacturer - Patch Panel:

Manufacturer	24 Port	48 Port	Strain Relief
Hubbell	HPJ24	HPJ48	CMBR
Siemon	KPNL-F1-24-01S	KPNL-F2-48-01S	KPNL-RWM
Panduit	CPPL24WBLY	CPPL48WBLY	SRB19BLY

2.8 HIGH IMPACT THERMOPLASTIC FACEPLATES WITH LABEL FIELDS

A. Verify color of faceplate with architect and engineer prior to ordering.

B. Approved Manufacturer -Faceplate:

Manufacturer	1-Port	2-Port	4-Port
Hubbell	IFP11W	IFP12W	IFP14W
Siemon	KFP-S-01-02	KFP-S-02-02	KFP-S-04-02
Panduit	CFPL1W	CFPL2W	CFPL4W

2.9 BACKBONE FIBER OPTIC CABLE

A.. Furnish and install a minimum of one (1) 12 strand fiber optic cable from the MDF to each IDF, unless otherwise indicated on backbone Riser diagram.

B. All indoor fiber optic cable shall be tight buffered construction with Interlocked Armored Plenum rated.

C. All outdoor or underground fiber optic cables shall be an indoor/outdoor jacket with tight buffered construction.

D. Approved Manufacturer - Indoor Interlocking Armored Fiber Optic Cable:

Manufacturer	Singlemode (OS2)
Hubbell	HFCD15012PS
Siemon	9BC5P012G-E205
Panduit	FSPP912Y

E. Approved Manufacturer - Indoor/Outdoor Fiber Optic Cable:

Manufacturer	Singlemode (OS2)
Hubbell	HFCD14012PSBK
Siemon	9GD8012G-E201
Panduit	FSCP912Y

2.10 FIBER OPTIC RACK MOUNT ENCLOSURE

A. Enclosure shall be mounted in standard 19" rack or cabinet. Shall have front and rear access on all modules via molded-hinged doors. Must have radius control and cable management for fiber patch cords. Shall have multiple cable entry locations. Include fiber optic cable routing kit (grommets, cable ties, saddle clips, strain relief bracket and ID/caution labels for various cable management solutions.

B. Approved Manufacturer - Rack Mount Fiber Optic Enclosure:

Manufacturer	1U	2U	4U
Hubbell	FCR1U3SPT	FCR2U6SPT	FCR4U15SPT
Siemon	LVE-1U-MD-P01A	LVE-2U-MD-P01A	LVE-4U-MD-P01A
Panduit	FCE1U	FCE2U	FCE4U

2.11 FIBER OPTIC ADAPTER PANELS

A. All adapter panels shall be LC form factor and use zirconia ceramic split sleeves. Use blank adapters in each empty port in each fiber optic enclosure.

B. Fill unused slots of fiber enclosure with blank panels

B. Approved Manufacturer - LC Adapter Panel:

Manufacturer	LC 12-Port OS2	LC 12-Port OM4	Blank Panel
Hubbell	FSPNLCDS6AQ	FSPNLCDS6AQ	FSPNB
Siemon	LVA12-LCQ-BC-A	LVA12-LCQ-BC-A	LVA-BLANK-01A
Panduit	FAP6WBUDLCZ	FAP12WAQDLCZ	FAPB

2.12 FIBER OPTIC CONNECTORS

A. Fiber connectors shall have a LC UPC interface. Connectors may be a mechanical or splice-on type connector.

B. Approved Manufacturer - Fiber Optic Connectors:

Manufacturer	LC; OS2 Mechanical	LC; OM4 Mechanical	LC; OS2 Splice-On
Hubbell	FCLC900KSM12	FCLC900K50GM12	FCLCF900SMBP
Siemon	FC1-LB-LCU-9BL	FC1-LB-LC5-9AQ	FC-F-LCU-29BL
Panduit	FLCSSCBUY	FLCSMCXAQY	FLCS2/9SOCU9BU

2.13 FIBER OPTIC PATCH CABLES

A. Contractor shall provide six (6) duplex fiber patch cords for each 12 strands of fiber installed. Patch cables shall be capable of connecting from fiber patch panel to owner provided equipment.

B. Fiber patch cables shall be manufactured in the USA.

C. Approved Manufacturer - Fiber Patch Cables Products:

Manufacturer	OS2; LC/LC; 1M; YL; Plenum	OM4; LC/LC; 1M; AQ; Plenum
Hubbell	DFHPCLCLCS1SM	DFHPCLCLCF1MM
Siemon	FPSLDLD001M	FP4LDLD001M
Panduit	F92RPU1U1ONM001	FZ2RPU1U1ONM001

2.14 Network/EQUIPMENT CABINETS

A. Secure cabinet per manufactures instructions and install 18" Ladder Rack from top of each rack to wall.

B. Each ladder rack shall utilize a "waterfall" or cable drop out at each 2-post rack to maintain the bend radius to each vertical cable manager.

C. Ground each cabinet per ANSI/TIA/EIA-607 Requirements.

D. Maintain 36" clearance from the front and rear of cabinet and on one side.

E. Where no dedicated MDF/IDF closet is available or space will not allow for the use of a floor mounted cabinet use a Wall Mount Swing Gate Style Cabinet

F. Where space is extremely narrow use Hubbell REBOX Part Number: RE4XB or equivalent.

G. Reference riser diagram to determine Cabinet type.
   1. Approved Manufacturer - Cabinets:
      a. Floor Cabinet

Manufacturer	45RU Floor Cabinet
Hubbell	H3S4748
Siemon	V62B-2AB121-45
Panduit	XG84822BS0005

      b. Wall Mount Cabinets

Manufacturer	24”H x 26”D Wall Cabinet	36”H x 26”D Wall Cabinet
Hubbell	HSQ2426	HSQ3626
Siemon	WC2-P101-12	WC2-P101-18
Panduit	PZWMC12W	PZWMC1830W

2.15 EQUIPMENT RACKS

A. Secure each 2-post relay rack to floor per manufactures instructions and install 18" Ladder Rack from top of each rack to wall.

B. Each ladder rack shall utilize a "waterfall" or cable drop out at each 2-post rack to maintain the bend radius to each vertical cable manager.

C. Ground each rack per ANSI/TIA/EIA-607 Requirements.

D. Maintain 36" clearance from the front and rear of rack and on one side.

E. If more than one rack is installed, install all racks in a straight line, side by side with vertical wire management between each rack (see section 2.26.B).

F. Where no dedicated MDF/IDF closet is available or space will not allow for the use of a floor mounted rack use a Wall Mounted Cabinet.

G. Reference riser diagram to determine rack type.
   1. Approved Manufacturer – Floor Racks:

Manufacturer	2-Post; 45RU Rack	4-Post; 45RU Rack
Hubbell	HPW84RR19	SF841929T
Siemon	RS1-07-S	RSQ1-07-S
Panduit	R2P	R4P

2.16 CABLE MANAGEMENT

A. Vertical Cable management shall be provided on each side and between each set of racks.

B. Install 6” vertical cable management at the end of each rack row and 10” vertical cable management between each rack.

C. Reference drawings for further detail:

D. Approved Manufacturer – Vertical Cable Manager:

Manufacturer	45RU; 6 in; Vert Cable Mgr	45RU; 10 in; Vert Cable Mgr
Hubbell	VM620	VM1020
Siemon	VCM-6D	VCM-10D
Panduit	PR2VD06	PR2VD10

E. Approved Manufacturer – Horizontal Cable Manager:

Manufacturer	Horz. Cable Mgr
Hubbell	HM277C
Siemon	RS-RWM-2DS
Panduit	CMPH2

2.17 LADDER TRAY FOR TELECOMMUNICATION ROOMS

A. All ladder tray shall be 18" in width and have 1 1/2" x 3/8" stringers, unless instructed otherwise per drawings,

B. Ladder tray shall be made of tubular steel; and the finish shall be black powder coat.

C. Furnish and install 18" ladder tray from each floor mount rack/server cabinet to wall. Furnish and install 18" ladder tray around wall as required to support cables. (A minimum of (2) walls shall be completely covered by ladder tray).

D. Furnish and install cable retaining post on each side of tray every 4ft as required to support cables.

E. A "waterfall" or cable drop out shall be utilized for each transition from ladder tray to vertical cable manager. A proper bend radius shall be maintained at all times.

F. All raw ladder tray ends shall be covered with a protective cap to match the color of the ladder tray itself.

G. Provide necessary accessories from original ladder rack manufacturer for a complete solution.

H. Approved Manufacturer – Ladder Tray:

Manufacturer	12 in Ladder Tray	18 in Ladder Tray
Hubbell	HLS0612B	HLS1018B
Legrand	TRT10-12B	TRT10-18B

2.18 RACK MOUNT PDU

A. ontractor shall provide and install (1) 30A/208V metered/switched vertical PDU in each cabinet or 4 post rack specified on project, and (1) 30 amp basic rack mount horizontal PDU in each floor mount 2 Post rack.

B. Approved Manufacturer – Power Distribution:

Manufacturer	Horizontal PDU	Vertical PDU
Hubbell	PHJB02	PV72IC30EBD-10
Panduit	P12B47M	P24E28M

2.19 COPPER BACKBONE CABLING

A. Furnish, install and terminate a minimum Cat3 100pr 24awg solid copper cable from the MDF to each IDF unless indicated otherwise on the Riser Diagram.

B. All indoor conductors are to be terminated on 100pr wall mount 110 terminal block kits. Each 100pr 110 block shall be terminated with C5 blocks.

C. Where cable routes above ceiling provide a plenum rated cable. Where cable routes underground provide an outdoor PE-89 type cable with building entrance protector at each end.

D. Approved Manufacturers – 100 Pair Cable:

Manufacturer	Indoor 100Pr Plenum	Outdoor 100Pr PE-89
Essex	18-799-36	09-104-92
Prysmian	2131758	7525819

E. Approved Manufacturers - 110 Block Kits:

Manufacturer	100pr 110 Terminal Block Kit with C5 blocks
Hubbell	18-799-36
Siemon	S110AA2-100FT
Panduit	P110KB1005Y

F. The building entrance protector shall be a 100 pair 110 in/110out with cover and splice chamber. Unit shall be 16awg powder coated and allow up to 22awg line termination. Unit shall be stackable for future expansion and equipped with internal fuse link and accommodate industry standard 5-pin protection modules. The unit shall be UL497 approved. Contractor shall fully populate each 5-Pin protector port with the specified protector module.

1. Approved Manufacturers – Building Entrance Protectors:

Manufacturer	100pr Building Entrance Protector	5-pin protection modules
CircaMax	1880ECA1-100	3B1E
Tii Technologies Inc.	24100-110-M110C	75-3C1EW-N

2.20 CATV HORIZONTAL CABLES

A. Coax Cable shall be Series 6 quad shield plenum rated.

1. Approved Manufacturers – Series 6 Cable:

Manufacturer	Series 6 Quad Shield; Plenum
Essex	78-14C-91
Prysmian	2131758

B. Coax Terminations & Connectors :

1. All coax shall be terminated with compression style connectors. All corresponding strippers and crimp tools shall be used for complete and proper termination.

2. Approved Manufacturers – Series 6 Connectors:

Manufacturer	Series 6 Compression Connectors
Hubbell	FRG625
Siemon	RG6C
Panduit	FSNS6U

2.21 GROUNDING AND BONDING

A. Grounding shall conform to ANSI-J-STD607(A)- Commercial building Grounding and bonding Requirements for Telecommunications, National Electrical Code, ANSI/NECA/BICSI-568 and manufacture's grounding requirements as minimum.

B. Bond and ground equipment racks, housings, messenger cables, and raceways.

C. Connect cabinets, racks, and frames to single-point ground which is connected to building ground system via (minimum #6) green insulated copper grounding conductor.

D. Contractor shall verify actual measurement of the Telecommunication Bonding Backbone (TBB) and size the bonding backbone accordingly.

E. Approved Products:

Manufacturer	Primary Bonding Busbar (PBB)	Secondary Bonding Busbar (SBB)	Compression Lug; 2-Hole	Ladder Tray Bonding Jumper Kit
Hubbell	HBBB14416H	HBBB14212	HGBLxxxx	HGRKTKA9KA5
Burndy	BBB14416H	BBB14212N	BGBLxxxx	BGRKTKA9KA5

F. Contractor to provide all additional necessary components, including but not limited to C-Taps, H-Taps, RB, RBC, TEBC

2.22 J-HOOKS

A. The cable support used must maintain complete horizontal and vertical 1" bend radius control.

B. Do not exceed EIA/TIA standards or manufactures recommendations of 40% fill ratio in each cable support.

C. All J-Hooks are to be placed no more than 4-5 feet apart.

D. Approved Products:
1. Hubbell
2. Caddy
3. B-Line

PART 3 - EXECUTION

3.1 PRE-INSTALLATION SITE SURVEY

A. Prior to start of system, meet at the project site with owner's representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Contractor will be necessary to plan the crucial schedule completions of the equipment room and telecommunication closet.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.

3.2 INSTALLATION GUIDELINES

A. The work included under this specification, consist of furnishing all labor, equipment, material, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The Telecommunications contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specification or not.

B. All work performed on this project will be installed in accordance with the current edition of the National Electrical code, the current edition of The National Electrical Safety Code, the current issue of the National Electrical Code, The current edition of ANSI/NECA/BICSI-568-Standard for Installing Commercial Building Telecommunications Cabling, the current edition of the BICSI Telecommunications Distribution Methods Manual, the current edition of the BICSI Cabling Installation Manual, the latest issue of ANSI/TIA/EIA Standards as published Global Engineering Documents as ANSI/TIA/EIA Telecommunications Building Wiring Standards, and all local codes and ordinances. Should conflicts exist with the foregoing, the authority having jurisdiction for enforcement will have responsibility for making interpretation.

C. If this document and any other documents listed above are in conflict, then the more stringent requirements shall apply. All documents listed are believed to be the most current release of the documents. The Vendor has the responsibility to determine and adhere to the most current release.

D. This document does not replace any code, either partially or wholly. The Vendor must be aware of local codes that may impact this project. All, local, State and federal codes are to be followed.

E. All materials shall be UL Listed or listed by other National Independent testing agency and shall be marked as such.

F. Section Includes: Equipment, materials, labor, and services to provide a complete structured cabling system including, but not limited to:
   1. Furnish and install a complete telecommunication wiring infrastructure.
   2. Furnish, install, terminate and test all copper and Optical fiber cables.
   3. Furnish and install Raceway, boxes, and cable tray.
   4. Furnish and install all wall plates, jacks, patch panels, and patch cords as described.
   5. Furnish and install all required cabinets and/or racks as required and as indicated.
   6. Furnish any other material required to form a complete system.
   7. Perform Link testing (100% of horizontal and/or backbone links) and certification of all components. All test must meet or exceed link testing requirements as specified in this document.
   8. Furnish test results of all cabling to the owner on disk and paper format, listed by each closet, then by workstation ID.
   9. Provide owner test results and documentation. (Testing documentation and as-built drawings).
   10. Removal of abandoned cable, if required.

3.3 WORK NOT INCLUDED

A. Unless otherwise indicated, the Vendor is not responsible for providing data concentrators, hubs, switches, servers, computers, and other active devices such as PBX's.

3.4 INSTALLATION

A. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local authorities having jurisdiction, and current National Electrical Code and with manufacturer's instructions.

B. Install in accordance with manufacturer's instructions.

C. All cable shall conform to the requirements for communications circuits defined by the National Electrical code (Article 800). Cable listed to NEC Article 800-51(a) will be used for "Plenum" installations. Cable listed to NEC Article 800-51(b) shall be installed in vertical runs penetrating more than one floor.

D. Adhere to manufacturer’s specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.
   1. Where manufacturer does not provide bending radii information, minimum-bending radius shall be 15 times cable diameter. Arrange and mount equipment and materials in a manner acceptable to the engineer and the owner.

E. Penetrations through floor and fire-rated walls shall utilize intermediate metallic conduit (IMC) or galvanized rigid conduit (GRC) sleeves and shall be fire stopped after installation and testing, utilizing a fire stopping assembly for that application. Contractor may also utilize EZ Path fire rated pathway or equivalent.

F. Install station cabling to the nearest telecommunications room (TR), unless otherwise noted.

G. Installation shall conform to the following basic guidelines.
Use of approved wire, cable, and wiring devices.
Neat and uncluttered wire termination.

H. Where cable tray is not used, attach cables to permanent structure with suitable attachments at intervals of 48 to 60 inches. Support cables above removable ceilings.

I. Follow manufactures recommendations on spacing and number and type of cables installed in j-hooks or cable tray to avoid cable stress.

J. Separation and physical barriers between communication cabling and power cables must be always maintained.

K. Install adequate support structure for 10-foot service slack at each TR.

L. Support riser cables every (3) floors and at top of run with cable grips.

M. Limit number of four-pair data riser cables per grip to fifty (50).

N. Install cables in one continuous piece. Splices or taps will not be allowed.

O. Provide overvoltage protection on both ends of cabling exposed to lightning or accidental contact with power conductors.

3.5 LABELING

A. Label each outlet with permanent self-adhesive label.

B. Label each cable within 1" of termination on each end.

C. Use labels on the face of patch panels. Provide facility assignment records in a protective cover at each telecommunications closet location that is specific to the facilities therein.

D. Use color-coded labels for each termination field that conforms to ansi/TIA/EIA-606(A)

standard color codes for termination blocks.

E. Labels shall be machine-printed. Handwritten labels shall not be acceptable.

F. Mark up floor plans showing outlet locations, type, and cable marking of cables. Turn these drawings over to the owner two (2) weeks prior to move in date.

G. Three (3) sets of as-built drawings shall be delivered to the owner within four (4) weeks of acceptance of project by the owner. A set of as-built drawings shall be provided to the owner in electronic form utilizing CAD software that is acceptable to the owner. The electronic media shall be delivered to the owner within six (6) weeks of acceptance of project by owner.
NETWORK CABLING COLORING GUIDE:
Wired IT – Blue
Wireless IT – Green
Fire Alarm – Red
GE Vitals – White
Security Cameras – Orange
Nurse Call – Purple
Card Access – Yellow

3.6 TESTING

A. Testing shall conform to ANSI/TIA/EIA-568-B.1 standard. Testing shall be accomplished using a level IIe or higher field testers.

B. All testing shall meet or exceed Manufactures recommendation for 25-year warranty program,

C. Test each pair and shield of each cable for open shorts, grounds, and pair reversal. Correct grounded and reversed pairs.

D. If copper backbone cable contains more than one (1) percent bad pairs, remove and replace entire cable.

E. If horizontal cable contains bad conductors or shield, contractor shall remove and replace cable at no additional cost to owner.

F. Test optical cable with a light source and power meter utilizing procedures as stated in ANSI/TIA/EIA-526-7 Measurements of Optical Power Loss of Installed Singlemode Fiber Cable Plant. Measure results shall be plus/minus 1 dB of submitted loss budget calculations. Correct improper splices and replace damaged cables at no charge to the owner.
1. Cables shall be tested at 1310 and 1550 for singlemode optical fiber.
2. Testing procedures shall utilize "Method B"- one jumper reference.
3. Bi-directional testing of optical fiber is required.
4. Submit printout for each cable tested. The use of handwritten test results will not be acceptable.

3.7 FIELD QUALITY CONTROL

A. Employ job superintendent or project manager during the course of the installation to provide coordination of work of this specification and of other trades and provide technical information when requested by other trades. This person shall maintain current RCDD (Registered Communication Designer) registration and shall be responsible for quality control during installation, equipment set-up, and testing.

B. Installation personnel shall meet manufacturer's training and education requirements for implementation of extended warranty program.

END OF SECTION 27 00 00

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Telecommunications mounting elements.
   2. Backboards.
   3. Telecommunications equipment racks and cabinets.
   4. Telecommunications service entrance pathways.
   5. Grounding.

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 12 inches (152 mm) in width.

C. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

D. LAN: Local area network.

E. RCDD: Registered Communications Distribution Designer.

F. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.

G. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
   3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of a

Registered Technician who shall be present at all times when Work of this Section is performed at Project site.

3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-D.

D. Grounding: Comply with ANSI-J-STD-607-D.

PART 2 PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-D.

B. Conduit and Boxes: Comply with requirements in Division 26 Section 26 05 33 "Raceway and Boxes for Electrical Systems."
1. Outlet boxes shall be 4”x4” with plaster ring
2. A double gang outlet box will be necessary for drops containing 4, 4 pair UTP cables.

2.2 BACKBOARDS

A. Backboards: Plywood is to be installed from the finished floor to a height of 8’ on all communications closet walls. The plywood is to be fire retardant treated, ¾”, Lumber Core, void free and painted with fire retardant paint.

2.3 GROUNDING

A. Comply with requirements in Division 26 Section 26 05 26 "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:
1. Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
3. Stand-Off Insulators: Comply with UL 94

C. Comply with ANSI-J-STD-607-D.

2.4 LABELING

A. Comply with TIA/EIA-606-D and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 EXECUTION

3.1 FIRESTOPPING

A. Seal penetrations through fire and smoke barriers.

B. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

C. Comply with TIA/EIA-569-D, Annex D, "Firestopping." Sections 07 81 00, 07 84 13

D. Comply with BICSI TDMM, "Firestopping Systems" Article.

E. Comply with 3M 4” Pass Through Firestopping system installation guidelines.

3.2 GROUNDING

A. Install grounding according to BICSI Telecommunications Distribution Methods Manual (TDMM), "Grounding, Bonding, and Electrical Protection" Chapter.

B. All sections of the ladder rack and equipment racks shall be connected to each other by bonding straps.

C. Comply with ANSI-J-STD-607-D.

D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

E. Locate grounding buss bar away from horizontal/vertical cable paths.

F. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
   1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.3 IDENTIFICATION

A. Owner’s IT representative shall review the identification plan.

B. Identify system components, wiring, and cabling complying with TIA/EIA-606-D. Comply with requirements in Division 26 Section 26 05 53 "Identification for Electrical Systems." For fire-resistant plywood, do not paint over manufacturer's label.

3.4 FIELD QUALITY CONTROL

A. After installing pathway components and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
   1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in pathway components, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
   2. Verify that the number, size, and voltage of cables in pathways do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
   3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
   4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of pathway ventilation.
   5. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

B. Report results in writing.

3.5 PROTECTION

A. Protect installed pathways.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by j-hook and cable tray manufacturer.

2. Install temporary protection for cables in pathways to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and pathways can be constructed of wood or metal materials until the risk of damage is over. Must be removed afterwards.

END OF SECTION 27 11 00

DIVISION

28

ELECTRONIC SAFETY AND SECURITY

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 INCLUDED IN THIS SPECIFICATION

A. Provide a complete fire alarm system per this project's plans and specifications. The system shall include a state-of-the-art, software-based control panel using addressable and analog type initiating.

B. These specifications and the accompanying Drawings define the intent of the fire alarm system to be provided. In addition to the system as specified herein and shown on the Drawings, the Contractor shall provide all planning, design, calculations, equipment, devices, raceways, boxes, cabling, system programming and any other component or service required for a complete, fully operational and code compliant system.

1.2 REFERENCES

A. Electrical Industries Association (EIA):
1. RS-232-D – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
2. RS-485 – Electrical Characteristics of Generators and Receivers for Use in Balanced Multipoint Systems

B. National Fire Protection Association (NFPA):
1. NFPA 12 – Standard on Carbon Dioxide Extinguishing Systems.
2. NFPA 13 – Installation of Sprinkler Systems.
3. NFPA 15 – Standard for Water Spray Fixed Systems for Fire Protection.
4. NFPA 16 – Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.
5. NFPA 16A – Standard for the Installation of Closed Head Foam-Water Sprinkler Systems.
6. NFPA 70 – National Electrical Code (NEC).
7. NFPA 72 – National Fire Alarm Code 2010 Edition
8. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
9. NFPA 101 – Life Safety Code 2012 Edition
10. NFPA 750 – Standard on Water Mist Fire Protection Systems.
11. NFPA 5000 – Building Construction and Safety Code.
12. IBC Chapters 9 & 10 2012 Edition
13. ADAAG Americans with Disabilities Act Application Guidelines

C. Fire Alarm Control Panel Equipment: System shall comply with applicable provisions of the following UL standards and classifications:
1. UL 864 9th Edition
2. UOJZ, Control Units, System.
3. SYZV Control Units, Releasing Device.
4. UOXX, Control Unit Accessories, System.

D. The Fire Alarm Control Panel's U.L. Listed signaling types shall be:
1. Digital alarm communicator
2. Other Technology

1.3 SUBMITTALS

A. Equipment Submittal Brochures:

1. Provide minimum 10 copies of submittal brochures and shop drawings.
2. Submittal brochures shall be bound my means of 3 ring binders, binding combs or similar. Stapled brochures will be rejected.
3. Provide one submittal brochure in color, highlighted and reserved for use by the Louisiana State Fire Marshal Plan Review Office. This copy shall become the record copy for the project.
4. Include a cover page that indicates the following minimal information:
   a. Project name and address.
   b. Engineered systems distributor's name and contact information.
   c. Installing contractor's name and contact information.
   d. The date of the equipment submittals and date of any subsequent required re-submittals. Indicate on revised submittals the original submittal date and re-submittal date.
   e. Architectural project review number assigned by the Louisiana State Fire Marshal's Office.
5. Provide a Scope of Work Narrative describing the system's basic operating premise in written word.
6. Provide a detailed Sequence of Operation Matrix Grid tailored for this project indicating the cause and effect of all fire alarm system control panels, input and output functions.
7. Include a system bill of material prepared specifically for this project. Include the make, model, description, quantity and manufacturer for every component to be installed in the project.
8. Provide manufacturer's data sheet for each component to be installed in the project. For data sheets that include multiple part numbers, options and accessories, the components included or pertinent to this project shall be highlighted in yellow.
9. Include the U.L. (Underwriters Laboratories) Certification for each component to be installed in the system. The U.L. Certification shall be placed directly behind its corresponding data sheet.
10. Manufacturers device compatibility documentation shall be included proving testing and operational compatibility between control panels and peripheral devices.
11. Separate battery calculations shall be provided for each control panel and prepared on manufacturer's official worksheets.

B. Shop Drawings
1. Shop drawings shall be prepared with the contractor's own title block which shall include:
   a. Project name and address.
   b. Contractor's name, address and phone number.
   c. Date.
   d. Drawing pages shall be numbered.
   e. Bound with spines and stapled.
   f. Floor plan scale.
   g. Louisiana State Fire Marshal architectural assigned project number.
   h. Revision number with re-submittal dates.
2. Drawings shall contain one floor per page. If a floor must be split use match lines and references that refer sheet number to match lines.
3. Floor plan shop drawings shall be prepared in AutoCAD.
4. Prepare floor plans to a 1/8" = 1'-0" scale unless directed otherwise by the architect.
5. Show all equipment, control panels, and device locations.
6. Include a distinct address for every device including panels, initiating, notification, auxiliary, and peripheral devices. All visual notification appliances shall have their candela indicated.

7. Floor plans shall include the following:
   a. Door swings.
   b. Room names and numbers.
   c. Reflected ceiling plan overlay.
   d. Ceiling heights.
   e. Fire and smoke barriers.
   f. Office furnishings when available.
8. Include a symbol schedule of devices for this project.
9. Include the necessary details and general notes for mounting heights, device placement restrictions, etc.
10. End-of-line symbols shall be shown on the floor plans.
11. Riser locations shall be indicated on the floor plan by a bold circle.
12. A detailed riser shall be provided as part of the shop drawings. The riser shall include:
    a. Control panels, power supplies, annunciators, demark cabinets, each identified with its own address and description matching the symbol schedule.
    b. Operating power requirements with breaker panel and breaker number identification.
    c. All system circuits including initiating, notification, SLC, power, control, monitor, network, audio, riser, fiber optic, phone, category cable and auxiliary circuits. Circuits shall be individually addressed indicating wire type, size, quantity and color.
    d. Provide a point to point diagram of every system device on its riser circuit using the exact device symbol as the floor plan. Provide the corresponding device address and candela rating next to each device.
    e. Provide the cumulative current draw at the end of each notification appliance circuit.
    f. Indicate location and placement of surge suppressors.
    g. Provide detail circuit diagrams for connections with systems from other trades.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name, number and manufacturer.

B. Store materials in clean, dry area indoors in accordance with manufacturer’s instructions.

C. Protect materials from damage during handling and installation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project and shall be supervised by a Nicet Level III Supervisor.
   2. Manufacturer’s product shall have been in satisfactory operation on three installations of similar size, type and design as this project, for approximately 3 years.
   3. The installing contractor shall have been actively engaged in the business of designing, selling, installing, and servicing fire alarm systems for at least ten (10) years.
   4. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Source Limitations: Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.

1.6 MAINTENANCE AGREEMENT

A. Contractor shall warranty material and installation against defects in manufacturing and workmanship for a period of one year beginning on the date of final acceptance of the project. Warranty related service calls shall be provided at no charge during the contractor's normal working hours.

B. Initial Maintenance Service: Beginning at Substantial Completion, provide full inspection and maintenance by skilled employees of manufacturer's designated service organization during the Warranty period, including any special warranty period specified.
   1. Include inspection, maintenance, testing, and repair contract in compliance with the manufacturer's recommended routine preventive maintenance program and NFPA 72 requirements necessary to maintain full ongoing listing on the complete installed system.
   2. Provide parts and supplies same as those used in the manufacture and installation of the original equipment.
   3. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification and listing of the completed system.

C. Extended Maintenance Service: Offer for the Owner's consideration and evaluation at the time of Product Data Submittal, a priced inspection, maintenance, testing, and repair contract in compliance with the manufacturer's recommended routine preventive maintenance program and NFPA 72 requirements necessary to maintain full ongoing listing on the complete installed system.
   1. The services offered under this contract shall begin after the completion of the Initial Maintenance Service and Warranty Period.
   2. The Owner shall have the option of renewing for single or multiple years, up to five years, at the price quoted upon completion of the Warranty period.
   3. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification and listing of the completed system.

1.7 COORDINATION

A. Coordinate installation and operational requirements for automatic elevator recall, including but not limited to the recall signal time frame, with Division 14 and with authorities having jurisdiction.

B. Coordinate installation and operational requirements for fire-protection systems, including but not limited to water-based sprinkler system, pre-action system and clean agent extinguishing system, with Division 21.

C. Coordinate installation and operational requirements for smoke control systems with Division 23.

D. Coordinate installation and operational requirements for kitchen fire-suppression systems with hood manufacturer, fire-suppression system manufacturer and with Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following are acceptable manufacturers and series for control panels. No substitutions are allowed.
   1. Edwards EST4 Series
   2. Notifier Inspire N16 Series

2.2 FIRE ALARM SYSTEM OPERATIONAL DESCIRIPTION

A. The fire alarm system shall be fully addressable with notification and initiation devices as shown on drawings. Additional components shall be provided as required for a complete, functional, and code compliant system.

B. Alarm Signals:

   1. Fire Alarm signal initiation shall be by one or more of the following devices and/or systems:
      a. Manual Pull Stations
      b. Heat Detectors
      c. Smoke Detectors
      d. Heat detectors in elevator shaft and pit.
      e. Automatic sprinkler system water flow
      f. Fire-extinguishing system operation including but not limited to fire suppression for kitchen, dry-pipe sprinkler system and pre-action sprinkler systems.
   2. Supervisory signal initiation shall be by one or more of the following devices and/or actions:
      a. Duct-Mounted smoke detectors.
      b. Valve supervisory switch. (Operation of a fire-protection system valve tamper switch.)
      c. Low-air-pressure switch of a dry-pipe sprinkler system.
      d. Low-air-pressure switch of a pre-action sprinkler system.
      e. Fire-pump running.
      f. Fire-pump power failure, including a dead-phase or phase-reversal condition.
      g. Elevator shunt-trip supervision.
   3. System trouble signal initiation shall be by one or more of the following devices and/or actions:
      a. Open circuits, shorts, and grounds in designated circuits.
      b. Opening, tampering with, or removing alarm-initiating and supervisory signal initiating devices.
      c. Loss of primary power at fire-alarm control unit.
      d. Ground or a single break in fire-alarm control unit internal circuits.
      e. Abnormal ac voltage at fire-alarm control unit.
      f. Break in standby battery circuitry.
      g. Failure of battery charging.
      h. Abnormal position of any switch at fire-alarm control unit or annunciator.

C. Specialized Alarm Actions:
   1. Elevator Recall: Activate elevator recall system to start in accordance with ANSI Standard A17.1 and NFPA 72. Comply with the following:
      a. Initiate Elevator Recall Sequence to return elevators to their primary or alternate recall floors upon receipt of a General Alarm by the Fire Alarm

Control Panel (FACP).

b. Smoke detectors designated for Elevator Recall shall be connected to fire-alarm system. Initiate a General Alarm upon detection of smoke.

c. Actuation of the elevator lobby detector located on the designated primary recall floor shall signal the cars to move to the alternate recall floor.

2. Elevator Shunt-Trip Operation: Heat detectors designated for elevator power removal shall be connected to fire-alarm system. Alarm-initiating devices, except those listed, shall not start elevator power removal.

a. Actuation of heat detectors in the locations indicated below shall shut down power, via a shunt trip operator, to the elevators associated with the location without time delay:

1) Heat detector in elevator machine room; locate detector within two feet of each sprinkler head.

2) Heat detectors in elevator hoistway; locate detector within two feet of each sprinkler head.

3. Air-Handling System Shut-Down: Upon receipt of a General Alarm by the Fire Alarm Control Unit perform the following, unless otherwise indicated in sequence for smoke control system or sequence for smoke venting system in a windowless anesthetizing locations:

a. Operate control relay contacts to signal shutdown of the Air-Handling system(s) serving the evacuation signaling zone where the alarm signal originated. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands. Coordinate and interface with Division 23.

b. Shut the smoke or combination fire/smoke dampers at that specific air-handling units' supply and return connections.

c. Shut all smoke and combination fire/smoke dampers associated with the air handling system.

d. Provide for an adjustable time delay, initially set at 20 seconds, to delay the transmission of close signals to the dampers. The intent of this time delay is to allow the air-handling unit fan(s) to receive the stop signal and slow down before closing any dampers in order to avoid a high static-pressure alarm/trip on the air-handling system.

4. Duct-mounted smoke detector: Duct-mounted smoke detector shall initiate the following functions, unless otherwise indicated in sequence for smoke control system or sequence for smoke venting system in a windowless anesthetizing locations:

a. Initiate a Supervisory Alarm.

b. Shutdown the associated air-handling unit.

c. Shut the smoke or combination fire/smoke dampers associated with that specific smoke detector and shut the smoke or combination fire/smoke dampers at the associated air-handling unit.

d. Provide for an adjustable time delay, initially set at 20 seconds, to delay the transmission of close signal to the dampers. The intent of this time delay is to allow the air-handling unit fan(s) to receive the stop signal and slow down before closing any dampers in order to avoid a high static-pressure alarm/trip on the air-handling system.

5. Kitchen Fire-Suppression: An alarm signal from the kitchen fire-suppression system shall initiate the following functions prior to discharge of fire extinguishing agent:

a. Initiate General Alarm when the kitchen fire-suppression system is activated.

b. Operate control relay contacts to remove power from equipment located equipment under kitchen hood. Relay control shall open circuit breaker

via use of breaker-mounted shunt trip operator(s).

c. Operate control relay contacts to close solenoid valve(s) to shut-off fuel supply to kitchen equipment under kitchen hood.

d. Operate control relay contacts to initiate the smoke evacuation system. Coordinate and interface with Division 23.

2.3 CONTROL PANEL

A. General Requirements:

1. The system shall have the capability of being activated into alarm, supervisory and trouble modes of operation from both manual and automatic devices.
2. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864

B. System Cabinet

1. Shall be all metal with a textured finish suitable for surface or semi-flush mounting. Cabinets containing anything non-metal are not acceptable.
2. Front door of steel construction with lockout or dead-front inner door of steel construction to conceal internal circuitry and wiring.
3. Cabinet shall be capable of housing batteries.
4. Cabinet shall be pre-fabricated to accept all available internal circuitry. Installations with loosely hanging internal panel components will not be accepted.

C. Main Power Supply

1. Shall incorporate the latest power-saving switching technology using no step-down transformers.
2. Shall provide minimum 7 amps of continuous rated output to supply all necessary power under normal and emergency conditions.
3. Shall include an internal battery charger capable of charging up to 55 amp hour batteries while under full load.
4. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the fire alarm control panel. A green “power on” LED shall be displayed continuously while incoming power is present at the building fire alarm control panel.

D. Batteries

1. Provide U.L. Listed batteries of sufficient capacity to provide power for the entire system automatically upon loss of AC power for a period of 24 hours with 15 minutes of alarm signaling at the end of the 24 hour period.
2. Battery connectors shall be the exact size and type required for the standby battery posts or tabs.
3. Connect batteries to the main panel with minimum 14 AWG stranded hook up wire. Red for positive and black for negative. Use fully insulated crimp style connectors.

E. Battery Cabinets

1. Provide U.L. listed metal battery cabinet and enclosures with key lockable door for installations requiring batteries too large to be housed in control panels.
2. Battery cabinet shall be textured painted to match the control panel it is housing the batteries for.

F. Display

1. Main control panel shall include a color touch screen display for user interface.
2. Display shall be capable of a minimum 200 characters.
3. The touch screen communications shall be textual RS-485 based with the capability of being mounted locally or remotely.

4. The display shall provide both audible and visual annunciation of all system events.
5. Separate LED's shall be dedicated for:
   a. AC (normal power): Green
   b. Fire: Red
   c. Hazard: Blue
   d. Supervisory: Yellow
   e. Trouble: Yellow
   f. Silenced: Yellow
6. Pre-programmed keys shall be on board for:
   a. Menu
   b. Fire Drill
   c. System Reset
7. Display shall contain a minimum 5 keys that can be custom programmed for system functions
8. The display shall be suitable to be remotely installed as a remote annunciator up to 3,000 feet away from the main CPU cabinet. The remote display shall be available with a manufacturer's custom metal cabinet suitable for surface or semi flush installation complete with a lockable see through door and textured finish matching the main control cabinet.

G. Main System CPU
1. System CPU shall incorporate a 32-bit RISC multiprocessor design on a single circuit board. An isolated watchdog circuit shall monitor the microprocessor and shall activate system trouble on the display upon any failure. The system program shall not be lost upon any loss of power. The CPU software shall support control-by-event (CBE) programming using Boolean logic including AND, OR, NOT, XOR and TIMING functions to provide complete custom programming flexibility. An auto programming option shall be available where only devices that are present on the SLC shall activate.
2. System shall be programmed via the manufacturer's proprietary field configuration program (FCP), allowing the project configuration custom programming to be uploaded and downloaded via a portable laptop computer at the project.
3. An RJ-45 Ethernet port shall be provided to accept downloaded programs from a portable computer, or provide 80-column readout of all alarms, troubles, location descriptions, time, and date. Communication shall operate at 10/100 speeds.
4. An on-board supervised RS-232C Serial Output shall be included to operate remote printers and video terminals.
5. The system CPU shall include an on-board supervised RS-485 Serial Output for connection and communication to system modules. The RS-485 port shall allow for communication with remote annunciator modules up to 3,000' from the cabinet.
6. Smoke detector alarm verification shall be a standard software option while allowing other devices such as manual stations and sprinkler flow to create immediate alarms. This feature shall be selectable for smoke sensors that are installed in environments prone to nuisance or unwanted alarms.
7. Standard software shall provide for the analog drift compensation of smoke detectors allowing each smoke detector to automatically adjust its sensitivity to accommodate changes caused by the effects of component aging or its surrounding environment including dust. Each sensor shall maintain its actual sensitivity under adverse conditions to respond to alarm conditions while ignoring factors which generally contribute to nuisance alarms. System trouble circuitry shall activate, display smoke detectors that require cleaning and maintenance.
8. System software shall automatically test each analog smoke sensor a minimum of 3 times daily. Test shall be a recognized functional test of each photocell

(analog photoelectric sensors) and ionization chamber (analog ionization sensors) as required annually by NFPA 72. Failure of sensor test shall activate system trouble circuitry, display “Test Failed” indication, and identify individual device that failed.

9. The system control panel shall be capable of setting any detector or sensor into Positive Alarm Sequence mode. Positive Alarm Sequence will operate in the following manner. Any alarms received from a device will activate an alarm at the control panel but will not execute any output functions (e.g. turning on the strobes or fire horns). The operator has 30 seconds to “acknowledge” the event or the system will activate a general alarm and sound all the fire horn and strobes. If the operator does acknowledge the vent within thirty (30) seconds, the panel will start a timer for 180 seconds (3 minutes) in which time the operator must find the device in alarm and reset the device. If the operator has not performed a reset within 180 seconds or a second device reports an alarm, the system will immediately sound the general alarm.
10. The CPU display shall have the option of being configured as an additional remote annunciator. This annunciator shall be mounted in its own metal cabinet with lockable door.
11. The CPU shall maintain a 4100 event history log. The log shall be maintained upon loss of any power.
12. 24 volt D.C. power-limited 1 amp outputs shall be provided for both resettable and non-resettable power. The outputs shall be screw terminal on board the CPU board.
13. Manufacturer’s standard software shall accommodate a 1 man walk test feature.

H. Signaling Line Circuits
1. Provide 1 SLC loop for this project. Projects including more than 1 floor shall include a second SLC loop. Each SLC shall be capable of being wired Class B Style 4 or Class A Style 6 and shall operate in NFPA Style 7 configuration when equipped with isolator modules.
2. Each SLC shall accommodate a maximum 159 analog sensors and 159 monitor/control devices.

I. Notification Appliance Circuits
1. The CPU shall include a minimum 4 on-board polarized NAC circuits rated at 2 amps DC each. Each NAC shall be capable of being wired Class B, Style Y or Class A, Style Z.

J. Dry Contacts
1. Form C dry contacts with a 2 amp at 30VDC resistive rating shall be included on-board the CPU for alarm, trouble and supervisory events.

K. DACT
1. Fire alarm control panel shall include a Digital Alarm Communicator Transmitter (DACT) for signaling to central station. DACT shall contain “Dialer-Runaway” feature preventing unnecessary transmissions as result of intermittent faults in system and shall be Carrier Access Code (CAC) compliant, accepting up to 20-digit central station telephone numbers. Fire department shall be consulted as to authorized central station companies serving municipality. Fire alarm system shall transmit both alarm and trouble signals, with alarm having priority over trouble signal. Contractor shall be responsible for all installation charges and Owner will be responsible for line lease charges
2. DACT shall be a U.L. listed internal component of the main control panel and shall be capable of transmitting specific detailed point by point system events to the monitoring station.
3. Systems using external standalone digital communicators will not be accepted.

L. Cellular/IP COMMUNICATOR
1. Provide a dual path commercial fire communicator as part of this project.
2. Acceptable manufacturers:
3. Fire-Lite Alarms Model IPGSM-4G by Honeywell. All equipment must be available "over the counter" through security equipment distributor network markets and can be installed by dealerships who are independent of the manufacturer. No substitutions allowed.
4. The central station's supervisory equipment shall be Honeywell's AlarmNet Network Control Center.
5. Contract the services of a monitoring company sub-contractor or distributor to provide, program the communicator and provide monitoring of the system.
6. The communicator shall use the internet or GSM cellular network as a primary transmission format.
7. IPGSM-4G Communicator is connected to any Fire Alarm Control Panel DACT telephone ports, the system shall be capable of transmitting Contact ID formatted alarms, supervisory or troubles to a Honeywell's AlarmNet Network Control Center equipped with a Honeywell AlarmNet receiver via Ethernet over a private or public WAN/LAN, Intranet or Ethernet.
8. The IPGSM-4G Communicator shall include connections to the Fire Alarm Control Panel's phone outputs and shall convert the contact ID protocol into Ethernet Packets.
9. The IPGSM-4G Communicator shall be completely field-programmable locally from a 7720P Programming Tool.
10. The IPGSM-4G Communicator shall be capable of transmitting events in contact ID format.
11. Communication shall include vital system status such as:
    a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
    b. Independent Addressable Device Status
    c. AC (Mains) Power Loss
    d. Low Battery and Earth Fault
    e. System Off Normal
    f. 24 Hour Test Signal
    g. Abnormal Test Signal (per UL requirements)
12. The IPGSM-4G Communicator shall support independent zone reporting via the Contact ID format. This format shall enable the central station to have details concerning the location of the fire for emergency response. The IPGSM-4G Communicator shall be capable of providing simulated phone lines to the Fire Alarm Control Panel. The IPGSM-4G Communicator shall communicate over IP or GSM primary and shall be transparent to the Fire Alarm Control Panel normal operation over phone lines.

2.4 VOICE EVACUATION PANEL

A. Provide a standalone voice evacuation panel from one of the approved manufactures

B. The voice evacuation panel shall be a single assembly complete with metal lockable enclosure, power supply, amplifier, audio controller board and supervised hand-held microphone.

C. Provide a system with 4 on-board circuits capable of supervising U.L. listed speakers.

D. The amplifier shall provide a minimum of 50 watts of output power on either 25 or 70.7 Vrms circuits.

E. The panel shall support a minimum of two pre-recorded messages and have the

capability of adding application specific messages through the use of a P.C.

F. The system audio notification emergency message shall initiate automatically from a supervised D.C. polarity reversing fire alarm notification appliance circuit.

G. The power supply shall be capable of charging up 18 amp hours batteries.

H. The audio controller board shall be complete with form C dry trouble and alarm contacts, and LED's for the following:
   1. Speaker circuit trouble
   2. Alarm
   3. Microphone trouble
   4. Ground fault
   5. Low battery
   6. Power fail

I. The system shall be available with a U.L. listed remote microphone accessory manufactured for the system.

2.5 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit.

2.6 GRAPHICAL WORKSTATION

A. UL-Listed Monitoring and Control System: Graphical workstation that includes a custom pictorial image of the protected premises. Include multiple PC-based workstations with graphics capability, with its operating system and application software, connected to data transmission network.
   1. UL Listed Monitoring and Control Locations: Provide a Graphic Workstation PC with Control Capabilities at the following locations.
      a. Central Plant
   2. Monitoring Only Locations: Provide a Monitor Only PC at the following locations.
      a. Reception

B. PC: Contractor shall provide PC cable of running all required software.

C. UPS: Desktop-Mounted Self-contained power source to supply computer and associated LCD monitor for a minimum of 6 hours of operation of workstation station equipment, including 2 hours of alarm printer operation.

D. Applications Software: Listed and labeled by an NRTL as an integral part of fire-alarm system.
   1. Fully compatible with and based on the approved operating system.
   2. Password-protected setup functions.
   3. Password-protected operator login and access; three levels, minimum.
   4. Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
   5. Capability for importing custom icons into graphic views to represent alarms and I/O devices.
   6. Automatic and encrypted backups for database and history; automatically stored at central control PC and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
   7. Operator audit trail for recording and reporting all changes made to user-defined

system options.

8. Data Formats:
   a. User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
   b. Option to convert reports and graphics to HTML format.
   c. Interactive graphics.
   d. Option to send preprogrammed or operator designed e-mail reports.
9. Graphics: Interactive color-graphics platform with pull-down menus and mouse-driven generation of life safety system graphics, in formats widely used for such drafting; to include the following:
   a. Site Plan
   b. Floor Plans
   c. Equipment Elevations
   d. Single-line diagrams
10. User-Defined Monitoring and Control Events: Display and record with date and time stamps accurate to 0.1 second, and including the following:
   a. Operator log on/off.
   b. Attempted operator log on/off.
   c. All alarms.
   d. Equipment operation counters.
11. Reporting: Display data acquired in real-time from different devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends. User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
   a. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
   b. Sort and report by device name and by function.
   c. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
   d. Differentiate alarm signals from other indications.
   e. When system is reset, report reset event with same information concerning device, location, date, and time.
   f. Spreadsheet functions of sum, delta, percent, average, mean, standard deviation, and related functions applied to recorded data.
   g. Charting, statistical, and display functions of standard Windows-based spreadsheet.
   h. Ability to produce all reports required in latest edition of NFPA 72 for system maintenance and record logs.

2.7 PRINTERS

A. A printer shall not be required for this project.

2.8 SUPPLEMENTARY NOTIFICATION APPLIANCE POWER SUPPLIES

E. The following are acceptable manufacturers and series for supplementary notification appliance circuit power supplies. No substitutions are allowed. It is the intent of this specification that all notification equipment must be available over the counter through security equipment distributor network markets
   1. APS6 of APS10 with the appropriate amp.

F. The supplementary NAC power supply shall offer up to 6.0 amps continuous regulated 24-volt power. The power supply shall include the following features:
   1. Integral Charger: Charge up to 35.0 amp-hour batteries and support 60-hour standby.
   2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire

alarm control panel) or supervised addressable relay.
3. Surface-mount back box.
4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
5. Power limited circuitry in accordance with applicable UL standards.
6. Operates as sync follower or a sync generator.
7. Shall have on-board built in sync capability for System Sensor and Wheelock brand appliances.

G. Do not exceed 75% of the power supply's available listed current. Provide the necessary quantity of power supplies to satisfy this requirement with the quantity of devices indicated on the plans.

2.9 SYSTEM PERIPHERALS

A. Every device's address shall be set by means of a rotary-decimal switch using a standard screwdriver. Devices using or requiring binary switches, handheld device programmers or addressed only through software mapping shall not be acceptable.

B. Smoke detectors

1. General Description:
   a. UL 268 listed, operating at 24-V dc, nominal.
   b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
   c. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
2. Photoelectric Smoke Detectors:
   a. Sensor: LED or infrared light source with matching silicon-cell receiver.
   b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
3. Duct Detectors
   a. Duct detectors shall be System Sensor DNR or DNRW Series housings.
   b. Housings and all the related accessories listed below shall be provided for the each of the following:
      1) On the ductwork of every supply branch of every HVAC air handling/rooftop unit exceeding 2,000 CFM
      2) On the ductwork of every return branch of HVAC air handling/rooftop unit exceeding 2,000 CFM. Where duct detectors cannot be practically or effectively installed on return ductwork, securely fasten the duct detector on the side of the AHU and install and secure its sampling tube across the front of the return air filter.
      3) On every shown smoke and fire/smoke damper. Where duct detectors cannot be practically installed on dampers consult with the general contractor to coordinate their installation with other trades.
   c. The housing shall include the listed addressable photoelectric smoke detector head which shall twist in and lock inside the housing.
   d. Provide System Sensor DST Series sampling tube of enough length to extend 75% of the width of the duct it is being installed in. Sampling tubes in ducts exceeding widths of 6 feet shall exceed and install across the entire width of the duct and be supported by drilling a hole in the opposite side of the ductwork.
   e. A System Sensor model RTS151KEY module shall be installed for each duct detector. Provide phenolic labels identifying the related HVAC unit it is connected to. The RTS151KEY module shall mount in a standard single gang electrical box. Verify and coordinate location of RTS151KEY

modules with architect.

f. Provide one addressable relay module for each HVAC required function including:
   1) AHU Shutdown
   2) Smoke damper operation
   3) Smoke sequence/exhaust/pressurization operations

g. System designs incorporating hardwired, conventional relays for any mechanical functions are not allowed and will be subsequently rejected.

C. Pull Stations
1. Shall be fully listed and compatible with the furnished system, dual action, and constructed of Lexan with clearly visible operating instructions provided on cover. The word FIRE shall appear on front of stations in raised letters.
2. Stations shall be designed so after actuation they cannot be restored except by key reset.
3. Stations shall be keyed alike with the fire alarm control panel and NAC power supply.
4. Surface boxes shall be available as an option from the manufacturer.
5. Pull stations shall not utilize glass rods.

D. Thermal Detectors
1. Shall be listed and compatible with the furnished system.
2. Detector shall be rated at 135 degrees and shall have rate of rise element rated at 15 degrees per minute.
3. UL521 listed

E. Beam-Type Smoke Detector: Each detector shall consist of a separate transmitter and receiver, and shall have the following features:
1. UL 268 listed, operating at 24-V dc, nominal.
2. Adjustable Sensitivity: At least six sensitivity levels, settable at the receiver, measured as percent of obscuration.
3. Two selectable alarm delay settings, allowing each to be associated with a corresponding sensitivity.
4. Separate Color-Coded LEDs: Indicate normal, alarm, and trouble status with remote indicator panels.

F. Addressable Monitor Modules
1. Where required provide addressable monitor modules to monitor normally open dry contacts from other non-addressable equipment.
2. Module shall be suitable for installation on a standard 4” square electrical box 2-1/8” deep and shall include the manufacturer’s matching cover plate.
3. An LED shall be visible on the outside of the module’s cover plate and shall flash under normal conditions and remain on steady when it’s connected device is in alarm.
4. Modules not suitable for mounting directly onto a 4” square electrical box or those which wire with pigtail type connectors are not acceptable.

G. Supervised Addressable Output Module
1. Provide addressable supervised output module where required for the project to provide a supervised, programmed 24volt DC reverse polarity output.
2. Module shall be suitable for installation on a standard 4” square electrical box 2-1/8” deep and shall include the manufacturer’s matching cover plate.
3. An LED shall be visible on the outside of the module’s cover plate and shall flash under normal conditions and remain on steady when the module is activated.

H. Addressable Relay Output Module
1. Provide addressable modules suitable for installation on a standard 4” square electrical box 2-1/8” deep and shall include the manufacturer’s matching cover plate.
2. The module shall provide two isolated sets of Form-C normally open and normally closed contacts
3. Contact ratings shall be rated at minimum 2.0 amps resistive or 1.0 amp inductive
4. An LED shall be visible on the outside of the module’s cover plate and shall flash under normal conditions and remain on steady when the module is activated.

I. Audio Visual Notification Appliances
1. Shall be System Sensor SpectrAlert Advance Series listed for use on both wall and ceiling as indicated on the plans.
2. Provide devices white in color with red FIRE screened on device from manufacturer.
3. Audio visual devices shall be one complete assembly utilizing a speaker for audible notification for this project.
4. The device shall be suitable for mounting on standard electrical boxes using the manufacturer’s universal mounting plate. The strobe device shall snap into the mounting plate and secured by one fastener.
5. The manufacturer’s mounting plate shall include screw terminals to accept all field wiring.
6. Candelas shall be selectable in settings of 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177 and 185.
7. The strobe shall be listed to U.L. 1971 standards and meet all current ADAAG Guidelines.
8. The horn shall be listed to U.L. 464 approved for fire protective service and shall have three audibility options and an output to switch between a temporal three pattern and a non-temporal continuous pattern.
9. Provide manufacturer’s surface mount and weatherproof backboxes where required.

J. MAGNETIC DOOR HOLDERS
1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   a. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
   b. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   c. Rating: 24-V ac or dc.

2. Material and Finish: Match door hardware.

2.10 WIRE AND CABLE

A. The following are acceptable manufacturers:
1. Windy City Wire
2. General Cable

B. Cable shall be approved for plenum use without conduit per the NFPA 262 Flame Test

C. Cable shall be approved per NEC 800, 760; UL, CMP, FPLP UL, RoHS Complaint

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive fire alarm system.
   1. Notify Architect of conditions that would adversely affect installation or subsequent use.
   2. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

A. Install fire alarm system in accordance with NFPA 72, NFPA 70, state and local codes, manufacturer's instructions, and as indicated on the Drawings.

B. Conceal conduit, junction boxes, and conduit supports and hangers in finished areas. Conceal or expose conduit, junction boxes, and conduit supports and hangers in unfinished areas.

C. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.

D. Flush-mount fire detection and alarm system devices, control panels, and remote annunciators in finished areas. Flush-mount or surface-mount fire detection and alarm system devices, control panels, and remote annunciators in unfinished areas.

E. Ensure manual stations are suitable for surface mounting or semi-flush mounting as indicated on the Drawings. Install not less than 42 inches, not more than 48 inches, above finished floor measured to operating handle.

F. Duct-Mounted Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

G. Heat Detectors in Elevator Shafts: Coordinate temperature rating, thermal response characteristic and location with sprinkler rating and location.

H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

I. Smoke- or Heat-Detector Spacing:

   1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing
   2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed the listing of the detector.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
   5. HVAC: Locate detectors not closer than 5 feet (1.5 m) from air-supply diffuser or 3 feet(1 m) from return-air opening.
   6. Lighting Fixtures: Locate centerline of detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide service of competent, factory-trained technician authorized by manufacturer to technically supervise and participate during pre-testing and acceptance testing of system.

B. Testing:
1. Conduct complete visual inspection of control panel connections and test wiring for short circuits, ground faults, continuity, and insulation before energizing cables and wires.
2. Close each sprinkler system control valve and verify proper supervisory alarm at Control Panel.
3. Verify activation of flow switches.
4. Open initiating device circuits and verify that trouble signal actuates.
5. Open signaling line circuits and verify that trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground initiating device circuits and verify response of trouble signals.
8. Ground signaling line circuits and verify response of trouble signals.
9. Ground notification appliance circuits and verify response of trouble signals.
10. Check installation, supervision, and operation of intelligent smoke detectors.
11. Introduce on system each of the alarm conditions that system is required to detect. Verify proper receipt and proper processing of signal at Control Panel and correct activation of control points.
12. Consult manufacturer's manual to determine proper testing procedures when system is equipped with optional features. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality, and similar.

C. Acceptance Testing:
1. Before installation shall be considered completed and acceptable by AHJ, a complete test using as a minimum, the following scenarios shall be performed and witnessed by representative approved by Engineer. Monitoring company and/or fire department shall be notified before final test in accordance with local requirements.
2. Contractor's job foreman, in presence of representative of manufacturer, representative of Owner, and fire department shall operate every installed device to verify proper operation and correct annunciation at control panel.
3. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.
4. When testing has been completed to satisfaction of both Contractor's job foreman and representatives of manufacturer and Owner, a notarized letter co-signed by each attesting to satisfactory completion of said testing shall be forwarded to Owner and fire department.
5. Leave fire alarm system in proper working order and, without additional expense to Owner, replace defective materials and equipment provided within 1 year (365 days) from date of final acceptance by the owner.

3.4 DEMONSTRATION

A. Provide instruction as required for operating fire alarm system.

END OF SECTION 28 31 00

DIVISION

31

EARTHWORK

SECTION 31 00 01 - EARTHWORK FOR BUILDING FOUNDATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 00 & 01 Specification Sections, apply to this Section.

B. Section 310000: “Earthwork”.

C. Section 033000: “Cast-in-Place Concrete”.

D. Division 01 Section: “Testing Laboratory Services”.

1.2 SUMMARY

A. This Section includes the following:

1. Earthwork at pile-supported concrete construction.

1.3 DEFINITIONS

A. Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.

C. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations, unless otherwise directed by Engineer.

D. Structure: Pile supported concrete construction occurring above or below ground surface.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction, including:
   1. Louisiana Standard Specifications: Comply with applicable requirements of "Louisiana Standard Specifications for Roads and Bridges," Latest Edition, of the Department of Transportation and Development, Office of Highways, unless requirements specified in this Section are more restrictive.
   2. Comply with applicable standards of Terrebonne Parish Department of Public Works, unless requirements specified in this Section are more restrictive, or as indicated elsewhere.
   3. OSHA.

1.5 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

B. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

C. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

D. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

E. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.

F. Provide minimum of 48-hour notice to Engineer and Utility Owner and receive written notice to proceed before interrupting any utility.

G. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

H. Use of Explosives: Use of explosives is not permitted.

I. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

J. Operate warning lights as recommended by authorities having jurisdiction.

K. Protect structures, utilities, sidewalks, driveways, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

L. Perform excavation by hand within drip-line of large trees to remain. Protect root systems from damage or dry out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

M. Protect job site from localized ponding by grading site so as to route runoff to the closest operational catch basin.

N. All clearing, and compaction operations shall be accomplished only during periods of dry weather.

O. Comply with L.R.S. 40: 1749.13 which states that no person shall excavate or demolish without first ascertaining the location of underground utilities by serving telephonic notice to a regional notification program. In the State of Louisiana, the regional notification program is Louisiana One Call (formerly DOTTIE) which may be reached by calling (504) 275-3700, or toll free at 1-800-584-4274, or by FAX (504) 272-1967.

P. Handling and Disposition of Stockpiled Material:
   1. All fill material to be delivered for the project and all excavated material to be removed from the project site shall be stockpiled on the site at a location designated by the Contractor. The edge of stockpiled material shall be at least 90 feet from proposed new

and existing pile locations.

2. The Contractor is cautioned that it is his responsibility to ensure that any excess stockpiled material is removed from the site, at no additional cost to the Owner. All necessary barriers, silt fences, and containment berms shall be installed as required to prevent storm water from washing any of the stockpiled material into the municipal storm drain system. All equipment used for transporting, moving or grading the stockpiled material will be thoroughly cleaned before they are removed from the site or taken onto public streets.

PART 2 – MATERIALS

2.1 SOIL MATERIALS

A. Fill Material: Lightweight coarse aggregate fill and backfill shall be expanded clay or approved equal produced by the rotary kiln process and meeting the requirements of ASTM C 330. No by-product slags, cinders, or by-products of a coal combustion shall be permitted. LWA shall have a proven record of durability, as estimated by ASTM C-88 and ASTM C 330; be non-corrosive; be non-plastic and free of wood, roots, clay lumps, and any other deleterious materials; and not contain more than 10% (by weight) of material passing a U.S. Standard No. 200 mesh sieve. The lightweight fill should have a gradation that allows for a maximum saturated unit weight of 70 pcf. Prior to transporting fill materials to the site, a sample shall be tested to verify its conformance to specifications.

B. Unacceptable Materials:
   1. "Spillway" sand shall not be used for any other purpose.
   2. Materials from on-site excavations shall not be used for any purpose, unless approved by Architect.
   3. Recycled material such as crushed concrete.

PART 3 – EXECUTION

3.1 EXCAVATION

A. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

B. Temporary Drainage: Prior to construction, establish adequate temporary and permanent drainage to prevent ponding water and to ensure immediate runoff of rainfall. The Contractor shall maintain adequate surface drainage away from all foundation and excavation areas during construction. Provide temporary sumps and pumps to remove rainwater from shallow excavations.

C. Access: Provide temporary haul roads and matting as required to perform the work. Protect existing subgrade(s) from damage throughout construction. Wheeled or tracked construction equipment exerting excessive ground pressures should not be used during times in which the subgrade may be saturated or may become saturated.

D. Demolition: Remove construction debris and structures from the project site. Existing footings, slabs, and utilities shall be removed and backfilled with structural fill. Existing piles shall be cut off 2 feet minimum below new pile-supported concrete construction. Demolition shall comply with Section 202 of the LSSRB.

E. Clearing and Striping: Remove from project site the existing sand fill down to EL. 2.00’ (NAVD 88) at the footprint of new pile supported construction. Top of existing, sand fill shall be assumed to be at EL. 9.50’ (NAVD 88) for bidding purposes.

3.2 STABILITY OF EXCAVATIONS

A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.

B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling. Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until backfilling operations are complete.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

D. Provide permanent steel sheet piling or pressure creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2' 6" below final grade and leave permanently in place.

3.3 EXCAVATED MATERIALS

A. Remove all stripped & excavated materials as well as excess fill material from the project site.

3.4 EXCAVATION FOR STRUCTURES

A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.

3.5 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.6 BACKFILL AND FILL

A. General: Place soil material in layers to required subgrade elevations using materials specified in Part 2 of this Section.

B. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Acceptance of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities or leave in place if required.
4. Removal of trash and debris from excavation.
5. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.7 PLACEMENT AND COMPACTION

A. Place lightweight coarse aggregate backfill and fill material in loose lift thickness of 8 to 10

inches with each lift compacted to 50% of its relative density in accordance with ASTM D4253 and D4254. Place fill from EL. 2.00' (NAVD 88) to underside of building's first floor slab.

B. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

C. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

D. Control soil and fill compaction, providing minimum percentage of density specified. Correct improperly compacted areas or lifts.

E. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.

F. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

G. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.8 TESTING LABORATORY SERVICES

A. An Owner selected and compensated independent testing laboratory shall perform the following services:
   1. Prior to transporting fill material to the project site, a sample shall be laboratory tested to verify its conformance with these specifications.
   2. Field Density Tests: At least one field density test for each 2500 square feet of fill at each lift.
   3. Submit reports to Owner, Architect, Engineer, and Contractor.

3.9 EROSION CONTROL

A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction. Provide, implement, and maintain a permitted Storm Water Pollution Prevention Plan (SWPPP).

3.10 DISPOSAL OF EXCAVATED AND WASTE MATERIALS

A. Removal from Owner's Property:
   1. Remove all excavated material, excess fill & backfill, trash, debris, and waste materials and dispose of it off Owner's property at a legal landfill.

END OF SECTION 31 00 01

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Soil and wood treatment with termiticide.

B. Related Sections:

1. Section 061000 "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of termite control product.

1. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

A. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

B. Wood Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Termiticide brand name and manufacturer.
3. Quantity of undiluted termiticide used.
4. Dilutions, methods, volumes used, and rates of application.
5. Areas of application.

C. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

B. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

C. Apply wood treatment after framing, sheathing, and exterior weather protection is completed but before electrical and mechanical systems are installed.

1.7 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.
    a. Contractor shall arrange for pre-payment of annual termite bond renewal for a period of five years to satisfy this requirement.

B. Wood Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied wood termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite damage is discovered during warranty period, repair or replace damage caused by termite infestation and treat replacement wood.

1. Warranty Period: 12 years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity.

Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following
   a. BASF Corporation; Termidor.
   b. Bayer Environmental Science; Premise Pro.
   c. FMC Corporation; Dragnet FT.
   d. Syngenta; Demon TC.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

2.2 WOOD TREATMENT

A. Borate: Provide an EPA-Registered borate temiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution for spray application and a gel solution for pressure injection, formulated to prevent termite infestation in wood. Provide quantity required for application at the label volume and rate for the maximum diffusible borate concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following
   a. Nisus Corporation; Bora-Care.
   b. NovaGuard Technologies, Inc; Shell-Guard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
2. Crawlspaces: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
3. Masonry: Treat voids.
4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.5 APPLYING WOOD TREATMENT

A. Application: Mix wood treatment solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of borate, according to manufacturer's EPA-Registered Label, so that wood framing, sheathing, siding, and structural members subject to infestation receive treatment.

1. Framing and Sheathing: Apply termiticide solution by spray to bare wood for complete coverage.
2. Exterior Uncoated Wood Trim and Siding: Apply termiticide solution to bare wood siding. After 48 hours, apply a seal coat of paint as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."."

END OF SECTION 313116

SECTION 31 62 01 – STEEL PIPE PILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 & 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Description:

1. The extent of the work is shown on the Drawings including number and location of the piling.
2. The work includes furnishing and driving required probe & job piling and performing static load tests.

B. Pile Type: This Section includes the following type of piling:

1. Open-end Steel Pipe Piling.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Cast-in-Place Concrete: Section 033000.

B. Field Engineering: 010500

C. Shop Drawings and Submittals: 013000

D. Material and Equipment: 016000

E. Division 01 Section - Testing Laboratory Services

F. Temporary Facilities, Utilities and Operations: 015000

1.4 DAMAGE TO EXISTING PROPERTY

A. Investigation: Contractor shall investigate the existing adjacent buildings, sewers, utilities, and site improvements and shall take proper and necessary precautions to protect same from damage due to the execution of the piling work. Should damage occur due to Contractor's negligence, the cost and responsibility for repairing or replacing the work in its original condition shall be borne by the Contractor at no cost to the Owner.

B. Documentation: The Contractor shall have photographs taken of exterior and interior of adjacent buildings and site improvements showing in full any damages that now exist.

1.5 NOTIFICATION

A. Requirements: Contractor shall notify Architect forty-eight (48) hours prior to driving the initial probe and job pile. Pile driving must not commence without the testing laboratory being present.

1.6 QUALITY ASSURANCE

A. Welders Qualifications: Qualify all welders, welding processes and procedures in accordance with AWS “Code for Welding in Building Construction.”

1.7 TESTING AND INSPECTING - GENERAL

A. Test Agency: Testing and inspecting shall be performed by an Independent Testing Laboratory capable of performing the testing specified herein.

B. Services: Testing Laboratory Services will include:

1. Inspections to certify materials’ conformity to detail and material requirements.
2. Witnessing and logging all pile driving operations.
3. Continuously monitor and record vibrations at two locations with seismographs during all pile-driving operations.
4. Verify locations of monitoring equipment with Owner and Architect prior to driving piles. Pile driving operations shall immediately be terminated, and the Architect contacted, if sustained vibrations exceed .25in/sec.
5. Pile numbering plan.
6. Load tests and report with interpretation of results.
7. Visual inspection of all welds.
8. Verify welder AWS certification for the type of welding being performed.

C. Steel Piles: All steel piles shall be inspected prior to driving by the Testing Laboratory. No piles shall be driven until inspected and approved. All piles are subject to re-inspection at any time, and any piles which fail to conform to Specifications or which have been injured in handling shall be rejected.

D. Driving Records: Record driving of all piles. Include Project name, name of Contractor, pile location and number, type and size of hammer used, type of pile driving cushion used, rate of operation of pile driving equipment, pile dimensions, elevation of tip, continuous record of number of blows for each foot of penetration, pile deviation and any unusual occurrences during pile driving.

E. Promptly submit copies of all test reports to Architect, Engineer, General Contractor, Pile Driving Contractor and Owner no later than five (5) days after completion of tests. Driving logs shall be submitted daily to the Engineer.

1.8 SUBMITTALS

A. General: Submit the following to the Architect for review.

1. Mill Certificates.
2. Shop Drawings for pile indicating pile dimensions, and details.
3. Driving Equipment: Descriptive data for hammer and other accessory equipment.
4. Concrete mix design.
5. Coal-tar epoxy coating.
6. Documentation of existing conditions.
7. Pile splice locations and detail (full penetration welded splice with continuous internal backer bar rings).
8. Welder AWS certifications.

1.9 DELIVERING, STORING AND HANDLING

A. Delivery Schedule:

1. Deliver materials to Project site in quantities and at times to assure continuity of pile driving operations to Project Schedule.

B. Storage: Store piles in orderly groups above ground and block during storage to minimize possible distortion of members. Piles exhibiting variations beyond mill tolerance limits will be considered distorted and shall not be used.

1.10 MEASUREMENT AND PAYMENT

A. Basis for Payment:

1. Contract price includes all labor, materials, tools, equipment, incidentals, & performance of all work for furnishing, driving, cutting off and related work for piles in place, including all splicing and disposal of cut offs.
2. No payment will be made for rejected piles, including piles driven out of place and out of plumb, imperfect piles, or piles damaged in driving or handling.

1.11 SUBSOIL INVESTIGATION REPORT

A. The data indicated in Subsoil Investigation Report are not intended as representations or warranties of continuity of such conditions. It is expressly understood that the Contractor is responsible for his interpretations or conclusions drawn there from. Data are made available for convenience of Contractor only.

B. Test borings and other exploratory operations may be made by Contractor at no additional cost to Owner, provided such operations are acceptable to Architect.

1.12 LOAD TEST PROGRAM

A. Description: Eight (8) probe piles are to be installed at non-permanent locations within the building footprint as directed by the Engineer. The Engineer will review driving data and select, in consultation with the Project Geotechnical Engineer, two probe piles suitable for reaction pile installation and load testing. The probe piles shall be driven to the specified tip elevation or refusal (whichever occurs first).
B. Pile Design Load to verified = 80 tons (Factor-of-Safety = 2.0).
C. General: Probe piles shall be same type and size as required for permanent job piles, and be driven with the same equipment to be used for permanent job piles. Reaction piles for use in load test shall be type, length and quantity as determined by the Contractor. Reaction piles shall not be used for permanent piles.
D. Contractors Responsibilities: Provide and drive probe piles. Design, furnish, and install reaction systems consisting of steel beam attached to reaction piles, arranged to permit application of load by hydraulic jacking between beam and test pile. Contractor shall assume responsibility for design and safety of reaction system to withstand test load equal to 3 times the pile design load, using a factor of safety equal to two (2). No reaction piles shall be driven closer than 8'-0" from the test pile, or 6'-0" from other permanent job pile locations. Provide flat bearing surface at the top of the pile perpendicular to the pile axis.
E. Driving Probe Piles:
   1. Paint-mark piles and pile driver leads with stripes at 1'-0" intervals and numerals at 5'-0" graduations.
   2. Drive probe piles with equipment specified.
   3. Drive probe piles to tip elevation indicated herein or refusal, whichever occurs first. Use pile length as needed to permit driving and load testing.
F. Load Test: The testing Laboratory will supply and calibrate jacks required, apply test load, and plot required curves for the report. Two probe piles shall be load tested.
   1. Method of Testing – In accordance with ASTM D-1143: Incrementally load to 2x design load or failure (whichever occurs first). Hold 2x design load for 12 hours. Decrementally unload to zero. Incrementally, load to 3x design load or failure (whichever occurs first).
   2. Test load shall be applied in increments, as directed by ASTM D-1143.
   3. "Quick-Load" test procedure shall not be used.
   4. Do not load test pile until fourteen (14) days after the reaction piles have been installed.
G. Permanent job piles shall not be ordered until the pile load test results have been reviewed by the Engineer.
H. After load test cut off reaction and probe piles 2'-0" below new construction."

PART 2 – PRODUCTS

2.1 STEEL PIPE

A. Description: .375 inch wall thickness, 14 inch diameter open-end steel pipe. Spiral welded pipe shall not be used.

B. Steel: Weldable conforming to ASTM A-252, Grade 3, yield-strength: 45,000 psi.

C. Fill earth plug within pile with concrete. Provide (1) - #6 vertical, full-length of earth plug, extending 8 inches into foundation. Remove soil material from within pile if required to achieve bottom of concrete fill at least 15-0" below first floor.

D. Coat upper portion of piles with coal-tar epoxy conforming to USACE standards to 20 feet below first floor.

2.2 DRIVING EQUIPMENT

A. Provide a single-acting air hammer delivering 24,000 ft-lbs. of energy per blow. Vibratory hammers are not acceptable. Jetting is not acceptable.

2.3 CONCRETE

A. 3000 psi 28-day compressive strength, normal-weight.

PART 3 - EXECUTION

3.1 COORDINATION

A. Comply with all local governmental regulatory requirements related to noise ordinances and hours of operation.

B. Obtain necessary permits from governing authorities.

3.2 PRE-DRIVING WORK

A. Examination: Examine areas and conditions under which steel piles are to be installed. Notify Architect in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Do not drive piles within 30 feet of any concrete or masonry structure, which is less than forty-eight (48) old.

C. Pile Length Markings: Mark leads and piling by painting a horizontal line at 1'-0" intervals and number of feet at 5'-0" intervals.

3.3 DRIVING

A. General Requirements:

1. Continuously drive each pile at locations indicated, to a tip elevation of 147 feet below first floor or refusal, whichever occurs first. Each pile shall be continuously installed to the required tip elevation without stopping from one day's installation to the next. Quantity of splices shall be determined by the Contractor.
2. Carefully maintain center of gravity for each group or cluster of piles to conform to locations shown on Drawings.
3. Carefully plumb leads and pile before driving. Take care during driving to maintain alignment between spliced sections.
4. When handling and driving long piles, take special precautions to ensure against over stress and leading away from a true position when driving.
5. Pile driving operations shall be terminated, and the Architect contacted, if sustained vibrations exceed .25 in/sec.
6. Fill earth plug inside pile with concrete. Install (1) - # (6) full-length reinforcing bar at center of pile at concrete filled plug. Extend #6 bar 8" into concrete foundation.
7. Pile group installation shall start at the center of the group, working outward.

B. Tolerances: Drive piles within the following maximum tolerances:
   1. Location: 3" from location indicated for center of gravity of each single pile for pile groups.
   2. Variation From Vertical: 1-1/2% maximum (excluding battered piles).
   3. Butt Elevation: Not more than 1 inch above or below designated elevation.

C. Damaged or Misdriven Piles:

   1. Damaged piles, and piles driven outside required driving tolerances, will not be accepted.
   2. Rejected piles shall be cut off 12 inches below bottom of pile cap.
   3. Drive additional pile or piles where centerline deviation exceeds 3" and a redesign indicates a load on any pile exceeding 110% of the design load.
   4. Piles rejected after driving shall be abandoned, filled and cut off. Additional piles shall be driven to replace rejected units at newly designated locations. Fill spaces that are left by withdrawn piles, using cohesionless soil material such as gravel, sand, broken stone, and gravel-sand mixtures. Place and compact throughout the length of the space.
   5. Additional quantities of piling, concrete, reinforcing steel, labor and all other materials and incidentals required for properly constructing redesigned pile caps due to damaged and misdriven piles shall be at the expense of the Contractor. No extensions of time and no delay-related cost claims will be entertained for rejected piles or reconfigured pile caps.

D. Cutting-Off: Cut-off tops of driven piles, square with pile axis and at elevations indicated. Grind flame-cut surface, level to 1/16" tolerance, using a power-hand grinder. Dispose of excess material off site. No additional contract cost or time will be allowed, regardless of the length of cut-off to be removed.

E. Following: Not acceptable.

END OF SECTION 31 62 01

DIVISION

32

EXTERIOR IMPROVEMENTS

SECTION 323113 – CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chain-link fence framework.

2. Chain-link fence fabric.

3. Chain-link fittings.

4. Chain-link wires and ties.

5. Chain-link swing gates.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for post footings.

2. Section 281500 "Integrated Access Control Hardware Devices" for gate controls.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct prior to installation.

1.3 ACTION SUBMITTALS

A. Product Data:

• Include materials, sizes, construction details, finishes for framework, fabric, fittings, and gates.

B. Shop Drawings:

• Include layout, elevations, post spacing, gate swing, hardware, and connections.

C. Samples:

• For factory-applied finishes, minimum 6-inch samples.

D. Delegated Design Submittal:

• Provide calculations signed/sealed by a licensed structural engineer, confirming fence and gate assemblies are designed for local wind loads.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data.

B. Product Certificates.

C. Product Test Reports.

D. Field Quality-Control Reports.

E. Sample Warranty.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify locations and grades.

1.6 WARRANTY

A. 5-year manufacturer warranty against structural failure and finish deterioration.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design Wind Load: Fence and gate framework shall withstand ultimate wind speed of 150 mph, Exposure Category C, as defined in ASCE/SEI 7-22 for Houma, LA.

B. Posts and framework to be sized in accordance with ASTM F1043 and CLFMI Wind Load Guide WLG2445.

C. ADA Compliance: Required for pedestrian gates.

2.2 CHAIN-LINK FENCE, GENERAL

A. Commercial-grade chain-link fence system compliant with CLFMI standards.

B. Single-source manufacturer preferred.

2.3 FRAMEWORK

A. Fence Height: 8’-0” (96 inches).

B. Material: Group IC – Electric-resistance-welded round steel pipe.

C. Pipe Sizes (minimum):

- Line Posts: 2.375 in OD, Schedule 40.
- End/Corner/Gate Posts: 2.875 in OD, Schedule 40.
- Top and Brace Rails: 1.66 in OD, Schedule 40.

D. Coating:

- External Type B: Zinc + clear polymer film over 0.9 oz/sf after welding.
- Optional: Polymer-coated, color selected by Architect per ASTM F934.

2.4 FABRIC

A. Height: 8’-0”.

B. Mesh: 2-inch diamond, 9-gauge core wire (0.148 in).

C. Finish:

- Zinc-coated per ASTM A392, Class 2 (2.0 oz/sf).
- Optional: Polymer-coated over galvanized.

D. Selvage: Knuckled both ends.

2.5 FITTINGS

A. All fittings to conform to ASTM F626.

B. Pressed steel with zinc coating min. 1.2 oz/sf.

C. Tie Wires: 9-gauge galvanized steel, matching fence fabric finish.

D. Truss Rods: Galvanized steel with turnbuckles.

2.6 TENSION WIRE

A. Metallic-coated 7-gauge (0.177 in) steel, matching fabric finish.

B. Optional: Polymer-coated for color match.

2.7 GATES

A. Swing Gates: ASTM F900, welded construction.

B. Posts:

- Single Leaf: 4.0 in OD Schedule 40.
- Double Leaf: 6.625 in OD Schedule 40.

C. Gate Frames: 1.90 in OD Schedule 40 steel.

D. Hardware:

- Hinges: 180-degree swing, tamper resistant.
- Latch: Lockable from both sides.

- Drop rods for double gates.
- Closers where required.

2.8 GROUT & ANCHORING CEMENT

A. Nonshrink grout: ASTM C1107.

B. Anchoring Cement: Hydraulic expansion, for exterior exposure.

2.9 CONCRETE

A. 2500 psi 28-day compressive strength.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify final grades, boundaries, and site conditions prior to installation.

3.2 PREPARATION

A. Stake layout, mark post and gate locations, identify utilities.

3.3 INSTALLATION

A. Install to ASTM F567 and manufacturer recommendations.

B. Post Installation:

- Set in concrete min. 10" dia. x 36" deep or per structural design.
- Top of concrete: 2" above finished grade, domed to shed water.

C. Post Spacing:

- Line Posts: 10' o.c. max.
- Terminal Posts: At corners, ends, and at 500' intervals.

D. Bracing:

- Horizontal rails and truss rods at mid-height.

E. Fabric:

- Attach to posts and rails with ties spaced at 15" max.
- Stretch fabric tight and secure with tension bars.

3.4 ADJUSTING

A. Adjust gates and hardware to operate freely without binding.

B. Replace or repair damaged components.

END OF SECTION 323113

TABLE OF CONTENTS

CIVIL SPECIFICATIONS

SECTION 1 INTENT OF SPECIFICATIONS
SECTION 2 REFERENCE SPECIFICATIONS
SECTION 3 WATER MAIN CONSTRUCTION
SECTION 4 SEWER SYSTEM

SECTION 1 – INTENT OF SPECIFICATIONS

1.1 It is the spirit and intent of these Specifications and the Drawings accompanying them and forming a part of the Contract Documents to which they are attached, to provide for the completion of the overall proposed project as is generally outlined in these contract documents.

1.2 The intent of the contract is to provide for performance and completion of the work described. The contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the plans, project specifications and terms of the contract.

1.3 When an item in the contract contains a choice to be made by the contractor, the contractor shall indicate the choice to the engineer in writing. When the project specifications reference or require the use of "manufacturer's recommendations or specifications", the contractor shall provide the engineer with a current copy of these recommendations or specifications.

1.4 The CONTRACTOR represents that it has examined all contract documents and has fully acquainted itself with all prevailing conditions relevant to the work at the site of the work and its surroundings, that it has made all investigations essential to a full understanding of the difficulties that may be encountered in performing the work, and agrees that OWNER and ENGINEER'S rules and procedures for coordinating CONTRACTOR activities with OWNER or his representative are acceptable; and is familiar with all local labor requirements, prevailing rates of wages, and general working conditions in the area. Having fully acquainted itself with the work, the site of the work, its surroundings and all risk in connection therewith, the CONTRACTOR assumes full and complete responsibility for completing the work for the compensation and within the time provided herein.

1.5 The ENGINEER retained by the OWNER is not responsible for the means, methods, techniques and safety precautions relating to the construction process. That responsibility rests with the CONTRACTOR who possesses authority over the construction site and over those performing the work on the site.

1.6 A diligent effort has been made to locate all existing underground utility lines, pipelines, telephone lines, drainage lines etc. that may be in potential conflict with this project. It is the CONTRACTOR'S responsibility to verify, at his expense, the exact location of those foreign lines both that are shown and those that are not shown that are in close proximity to the project. The CONTRACTOR is solely responsible for any damages incurred by crossing these foreign lines and agrees to "Hold Harmless" both the Project OWNER and the ENGINEER from any claims arising from damages caused by the crossing. The CONTRACTOR will cross all foreign lines in a manner acceptable to the foreign line OWNER, the Project OWNER and the ENGINEER.

1.7 This agreement contains detailed provisions requiring CONTRACTOR to conduct his work in such a fashion as to avoid injury to its employees, neighboring landowners, and members of the general public. CONTRACTOR acknowledges that compliance with these provisions and its duty to exercise reasonable care is specific obligations under this agreement.

END OF SECTION 1

SECTION 2 – REFERENCE SPECIFICATIONS

2.1 ALL WORK TO BE IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS THAT ARE MADE PART OF THIS DOCUMENT BY REFERENCE INCLUDE THE FOLLOWING:

2.2 U.S. Dept. of Transportation, MUTCD Manual or Uniform Traffic Control Devices 2000, edition (or Latest Revision).

2.3 Louisiana Department of Transportation and Development, 2016 edition (or Latest Revision) of Louisiana Standard Specifications for Roads and Bridges unless otherwise stated. Inclusive, special attention is called to the sections listed below. All Sections exclude terms portions of each section referring to payment. These Sections can be obtained from the Louisiana Department of Transportation and Development website at **http://www.dotd.la.gov/highways/specifications/DirListing.aspx?txtPath=/highways/specifications/documents/2016 Standard Specifications for Roads and Bridges Manual**.

2.3.1 Section 101 - General Information, Definitions and Terms
2.3.2 Section 201 - Clearing and Grubbing
2.3.3 Section 202 - Removing or Relocating Structures and Obstructions
2.3.4 Section 203 - Excavation and Embankment
2.3.5 Section 204 - Temporary Erosion Control
2.3.6 Section 302 - Class II Base Course
2.3.7 Section 402 - Traffic Maintenance Aggregate
2.3.8 Section 502 - Asphalt Concrete Mixtures
2.3.9 Section 601 - Portland Cement Concrete Pavement
2.3.10 Section 701 - Culverts and Storm Drains
2.3.11 Section 702 - Manholes, Junction Boxes, Catch Basins, and End Treatments
2.3.12 Section 706 - Concrete Walks, Drives and Incidental Paving
2.3.13 Section 707 - Curbs and Gutters
2.3.14 Section 713 - Temporary Traffic Control
2.3.15 Section 726 - Bedding Material
2.3.16 Section 727 - Mobilization
2.3.17 Section 737 - Painted Traffic Striping
2.3.18 Section 740 - Construction Layout
2.3.19 Section 812 - Treated Timber
2.3.20 Section 901 - Portland Cement Concrete
2.3.21 Section 1003 - Aggregates
2.3.22 Section 1014 - Timber, Timber Connectors, and Preservatives
2.3.23 Section 1019 - Geotextile Fabrics and Geocomposite Systems

END OF SECTION 2

SECTION 3 - WATER MAIN CONSTRUCTION

3.1 GENERAL CONDITIONS:

3.1.1 GENERAL:

3.1.2 It is the intention of these specifications to provide standards for the construction of a water distribution system within Development/Subdivision within Terrebonne Parish, Louisiana.

3.1.3 Where ever a standard specification is referred to, it is intended that the latest revision effective as of the date of plan approval shall apply.

3.1.4 The PROJECT ENGINEER shall consult with the DISTRICT for standards or materials not covered by these specifications.

3.1.5 For purposes of these specifications the following definitions shall apply:

3.1.5.1 Consolidated Waterworks District No. 1 (District): The political subdivision created by a resolution of the Terrebonne Parish Consolidated Government adopted on March 23, 1994 and governed by its Board of Commissioners, and commencing operations on July 1, 1994.

3.1.5.2 Contractor: Any person, group or corporation acting as a unit or an agent thereof, licensed as required by the State of Louisiana, engaging in the construction of a water transmission system to be connected to the public water supply of the District.

3.1.5.3 Owner: The sub-divider or developer.

3.1.5.4 Project Engineer: An Engineer, registered in the State of Louisiana, retained by the sub-divider/developer to design and administer the construction of improvements in a subdivision/commercial development.

3.1.5.5 Project Representative: The PROJECT ENGINEER'S representative at the construction site.

3.2 PRODUCTS INFORMATION:

3.2.1 Manufacturer's warranty for all material and products to be furnished by the CONTRACTOR and to be incorporated into the completed work shall be furnished to the DISTRICT through the PROJECT ENGINEER.

3.2.2 The manufacturer of all material and products shall furnish complete information as to any special conditions or restrictions to be applied in the use of these items. Should the manner or method of installation, specified performance or test results as set forth in these specifications be contrary to the manufacturer's recommendations for use of the project, the manufacturer shall at once notify the PROJECT ENGINEER who shall forward same to the DISTRICT for appropriate action. Lack of such notification shall be certification by the CONTRACTOR that specification requirements will be met by the material and products under project conditions.

3.2.3 Data submitted on all material shall include complete maintenance instructions and parts list in sufficient detail to facilitate ordering replacements.

3.2.4 Manufacturer's installation guide shall be followed during construction of pipelines. Before construction begins, three (3) copies of the installation guide shall be submitted to the DISTRICT. One copy bearing the DISTRICT'S approval shall be at the job site of installation and the instructions carried out by the foreman in charge of the crew.

3.3 SPECIAL CONSTRUCTION:

3.3.1 Special construction projects, such as submarine crossings, pile crossings, bulkheads, roadway crossings, etc. shall be submitted to the DISTRICT for approval prior to construction.

3.3.2 Asbestos Concrete (AC) materials are governed under Federal, State and local laws. The contractor shall adhere to all Federal laws, State laws, and Consolidated Waterworks District No. 1 policies. This includes but not limited to OSHA, EPA, LaDEQ, and La DHH. The contractor shall either be properly licensed to perform the necessary AC work, engage the services of a properly licensed sub-contractor or engage the District through its current policies. I shall be the sole responsibility of the contractor to ensure regulatory compliance for the handling and disposal of AC materials.

3.4 CHANGES IN PLANS:

3.4.1 Should it be necessary to change the location or elevation of the waterline or any other detail as shown in the drawings after receiving DISTRICT approval, then such change shall be brought to the DISTRICT for approval prior to making the change in the construction.

3.4.2 All change in construction from that shown in the approved drawings shall be shown on the record drawings submitted for the final approval.

3.5 RECORD DRAWINGS:

3.5.1 One (1) copy of the test reports, manufacturer's submittals, record drawings and one (1) computer disk of the record drawings, shall be submitted with the PROJECT ENGINEER'S letter requesting final approval and acceptance of the waterline project. Record drawings shall indicate the location and GPS coordinates on the waterline at reasonable intervals and on all valves, hydrants and fittings greater than 45 degrees. The depth at all conflicting utility or ditch crossings shall also be shown.

3.6 STORAGE OF MATERIALS:

3.6.1 Materials shall be stored so as to insure the preservation of their quality and fitness for the work, and in such a manner that leaves the material accessible for inspection by the DISTRICT.

3.7 WATER PIPELINE MATERIAL

3.7.1 GENERAL:

3.7.2 Waterline material, as indicated on the plans, shall be Polyvinyl Chloride, bell and spigot type with single rubber gasket seals of the push-on type, or butt fused polyethylene pipe.

3.7.3 All pipes shall be in first class condition at the time it is installed in the work.

3.7.4 All pipes shall be designed for a minimum working pressure of 150 psi, plus a surge pressure of 100 psi and an overall minimum safety factor of 2.5. Design laying conditions shall be Class B, WPCF Manual of Practice No. 9 (Page 212) for a maximum cover as indicated on the plans. Design factors for pipe shall be furnished to the PROJECT ENGINEER.

3.8 POLYVINYL CHLORIDE PRESSURE PIPE:

3.8.1 All pipe 12-inches and smaller for the distribution system shall meet or exceed the requirements of ASTM D-1784, "Standard Specifications for Rigid Poly (Vinyl Chloride) compounds; and AWWA Specifications C-900, pressure rating class 150, SDR 18 with design factors as given in paragraph 1(c) herein. Pipe shall be Type I, Grade 1 (12454B) with a hydrostatic design stress of 2000 psi, designated as PVC 1120 or equivalent.

3.8.2 All plastic pipes shall have outside diameters equivalent to the OD of cast iron pipe.

3.8.3 Wall thickness and outside diameter subject to tolerance allowed in AWWA C-900 shall be as shown on the following table:

Nominal Size	Average	OD Tolerance	Wall Minimum	Thickness Tolerance
4" 4.80"	+0.009	0.267	+0.032	
6" 6.90"	+0.011	0.383	+0.046	
8" 9.05"	+0.015	0.503	+0.060	
12" 13.20"	+0.015	0.733	+0.088	

3.8.4 Polyvinyl chloride pipe shall be furnished in 20-foot lengths.

3.8.5 Rubber ring gaskets shall conform to ASTM D-1869. Couplings and gaskets shall provide automatic end separation without auxiliary spacing devices.

3.9 POLYETHYLENE (PE) PIPE:

3.9.1 All PE pipe and fittings shall be made from virgin resins exhibiting a cell classification of PE 345464C as defined in ASTM D3350 with an established hydrostatic-design-basis (HDB) rating of 1,600 psi at 73°F for water. All PE pipe and fittings shall be manufactured in accordance with AWWA C-906. The pipe shall be Series 4000, pressure Class 160, SDR11, unless specifically stated otherwise. The material shall be listed and approved for potable water in accordance with NSF Standard 61. All PE pipe shall have outside diameters (OD) equivalent to the OD of cast iron pipe.

3.9.2 Pipe joints shall be joined by means of zero leak-rate heat fusion or electro fusion method and shall be installed in strict accordance within the pipe manufacturer's recommendations.

3.10 DUCTILE IRON PIPE:

3.10.1 Pipe shall be designed in accordance with ANSI Specifications ANSI/AWWA C150/A21.50, "American National Standard for the Thickness Design of Ductile Iron Pipe". Pipe shall be designed for a working pressure of 150 psi and a minimum surge allowance of 100 psi; trench conditions Type 2, with width of d+2 feet and depth of cover 3 to 8 feet with overall minimum safety factor of 2.5.

3.10.2 Pipe shall be manufactured in accordance with AWWA Specifications ANSI/AWWA C151/A21.51 with minimum wall thickness subject to tolerance allowance allowed in said specification under Class 51 for pipe size indicated.

3.11 CAST IRON AND DUCTILE IRON FITTINGS:

3.11.1 Fittings shall be furnished in accordance with ANSI/AWWA C-110-A21.10 or C153-A21.53. Joints shall be of the type called for on the plans and shall be push-on or mechanical joints conforming to ANSI/AWWA C-111-A21.11. Consideration will be given to alternate joint

configuration; however, such alternate shall receive approval of the DISTRICT prior to installation.

3.11.2 Fittings 12 inches and smaller shall be rated for 250 psi water working pressure.

3.12 LINING AND COATING OF FITTINGS:

3.12.1 All cast iron and ductile iron fittings shall have an inside cement mortar lining conforming with Specification for Cement Lining for Cast Iron Pipe and Fittings ANSI/AWWA C104-A21.4 or manufacturer's standard specifications for seal coated "enamel-line" type cement lining or equal. Outside coating shall conform with ASA Specifications for Coal-Tar Dip Coating for Cast Iron Pipe and Fittings (A21.5; A21.10), latest revision. Thickness shall be standard thickness.

3.13 DUCTILE IRON FITTINGS - SPECIAL COATINGS:

3.13.1 Ductile iron fittings may be lined and coated, in and out, with an approved amine-cured epoxy resin. This epoxy resin is molecularly bonded to the metal assuring permanents without flaking and shall be of 12 mil thickness. This lining and coating shall be done by the manufacturer in order to insure uniformity.

3.14 P.E. FITTINGS:

3.14.1 Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and shall be so marked. Molded fittings shall be tested in accordance with AWWA C906.

3.14.2 Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings. Fittings shall be molded or fabricated of the same material and manufacturer as the pipe; and in no case shall have thinner walls than those of the pipe furnished. All custom fabricated fittings shall be pressure rated for the same internal pressure rating as the mating pipe. Fittings shall be of butt fusing design and shall be produced by the same manufacturer as the pipe being bid. Fabricated fittings shall be tested in accordance with AWWA C906.

3.14.3 If required, a sample of each type fitting shall be submitted for the PROJECT ENGINEER'S approval, and his approval must be obtained before purchase of the fittings.

3.15 ACCESSORIES:

3.15.1 The supplier of cast iron or ductile iron fittings shall furnish all glands and gaskets as recommended by the manufacturer and approved by the DISTRICT. All bolts and nuts shall be Corten; Teflon coated Corten or stainless steel. No direct payment will be made on these items; the cost of same to be included in weight paid for the fitting.

3.15.2 All tie rods shall be 316 stainless-steel. When required, tie rods shall be used to secure all bends ends of pipe, caps, plugs, etc. and all places where thrusting may produce “blow outs”. These tie rods will be used in conjunction with properly sized bands which will attach circumferentially to the pipe. Hot-dipped galvanized bands shall be coated with an approved bitumastic coating before and after installation.

3.15.3 Adapters between PE pipe and flange fittings shall be made with a Harvey adapter or approved equal.

3.16 JOINTS:

3.16.1 Joints of the push-on type shall conform to ASTM Specifications C-111-ASA A21.11.

3.16.2 Mechanical joints shall be in accordance with ASA Specifications A21.11 with Corten, Teflon coated Corten or stainless-steel bolts.

3.16.3 Joints of the restrained type shall be U.S. Pipe's TR FLEX restrained joint pipe, American's LOK-RING restrained joint, or CLOW'S Super-Lock joint pipe, or an approved equal.

3.16.4 Retainer glands, when allowed, for ductile iron pipe and PVC pipe 12-inches and smaller shall be EBAA, or NAAPCO glands with stainless steel set screws or approved equal.

3.17 FLANGED FITTINGS AND SPECIALS:

3.17.1 Flanged fittings shall conform in dimensions, methods of manufacture and tests to the "Standard Specifications for Cast Iron Pipe and Fittings", as adopted by ANSI Class 125.

3.17.2 All flanges and fittings shall conform in weight, thickness and drilling to the "Standard Specifications for Class 125 Cast Iron Flanges and Flanged Fittings", as adopted by ANSI. All flanges shall be faced and drilled, unless special drilling is required as detailed or specified on the plans. All drilling shall conform to the ANSI standards. Where cap screws or stud bolts are required by the plans or specifications, flanges shall be provided with tapped holes for such cap screws or stud bolts.

3.18 TAPPING SLEEVES:

3.18.1 Tapping sleeves shall be the stainless-steel sleeve type. The body shall be a full circle band that meet or exceeds the Waterworks Specifications for repair clamps, stainless steel 18-8 type 304 with gridded overlapping virgin neoprene rubber gasket. The flange shall be 304 (18-8) stainless steel or ductile iron AWWA C207 Class D ANSI 150 lb. drilling recessed to accept a standard tapping valve. Taping sleeves shall be Rockwell 662 or approved equal.

3.18.2 Tapping sleeve valves shall be similar to the valves specified in Division IV.

3.18.3 All bolts and nuts shall be Corten; Teflon coated Corten or stainless steel.

3.19 TESTS AND INSPECTIONS:

3.19.1 All pipe and fittings shall be inspected and tested at manufacturer's plant during manufacture in accordance with manufacturer's standard test procedures at the manufacturer's expense.

3.19.2 For ductile iron fittings, chemical analysis shall be furnished indicating the use of 80-06-03 metal in accordance with ASTM Specifications A339.

3.19.3 For polyvinyl chloride (PVC) pipe, all pipe and couplings shipped must be accompanied by the manufacturer's certificates of test and conformity to applicable ASTM and AWWA Specifications.

3.19.4 Testing of PE pipe and fittings supplied under this specification shall be in accordance with ASTM D-3350.

3.19.5 A letter shall be submitted to the PROJECT ENGINEER by the PE material manufacturer certifying that materials to be furnished meets or exceeds the requirements of AWWA C-906.

3.19.6 The test reports shall be submitted by the PROJECT ENGINEER to the DISTRICT with the request for final acceptance. These test reports shall certify that material furnished under this contract is in compliance with these specifications.

3.19.7 For polyvinyl chloride pipe, quality control shall randomly select pipe to check SDR requirements. This shall be done by cutting the pipe and measuring the actual wall thickness by the use of a micrometer. Result of check shall be submitted to the Project Representative.

3.20 WATER MAIN CONSTRUCTION AND INSTALLATION

3.20.1 GENERAL:

3.20.2 The construction of water lines includes the furnishing of all material in accordance with these specifications and all labor and equipment required for the installation of pipe, fittings, valves, road crossings, canal crossings, stream crossings, ditch crossings, and all incidental work required for completion of the water line system.

3.20.3 The installation of waterlines shall be in accordance with the manufacturer's pipe handbook and instructions.

3.21 DELIVERY OF MATERIAL:

3.21.1 Pipe shall be strung along the line of work in a manner that will not cause it to be a hazard to the public, block traffic or access to property, nor shall it be placed in a drainage ditch.

3.21.2 Protective coated fittings shall be received, stored and transported to a point of installation in a manner that will adequately protect the coating. Damaged coating will be cause for rejection of the fittings.

3.21.3 All pipes shall be removed from the transporting vehicle in a manner recommended by the manufacturer. Pipe removed from the vehicle in a manner not acceptable by the DISTRICT and/or manufacturer will be rejected.

3.22 CARE OF WORK AND MATERIAL:

3.22.1 The CONTRACTOR shall at all times handle, transport and install all material with the degree of care required to assure that these materials are in first class condition when installed.

3.23 INSPECTION OF MATERIALS:

3.23.1 The CONTRACTOR'S quality control representative shall inspect all materials before they are installed in the work, and shall ascertain that satisfactory test reports have been submitted to the PROJECT ENGINEER covering materials inspected. All material found to be defective shall be immediately removed from the work.

3.23.2 Should hidden or unobserved defects be discovered by the PROJECT ENGINEER after the material is in place or show up during testing, the CONTRACTOR shall be required to remove the defective material and replace it with satisfactory material. The CONTRACTOR shall be solely responsible for the quality of the material he supplies for installation in the work and shall have the full responsibility of obtaining material meeting the requirements of these specifications.

3.24 DEPTH OF LINES:

3.24.1 All water mains shall be laid to line and grade as shown on the plans. In general, a minimum cover of thirty (30") inches and a maximum cover of forty-two (42") inches shall be required from the finished ground surface.

3.24.2 The alignment and/or grade may be altered by the PROJECT ENGINEER or his representative as required because of interference with other pipes or structures and to get below ditch bottoms. In general, a minimum of two (2') foot cover is required in a ditch, or canal crossings and an eighteen (18") inch clearance is required below pipeline crossings. These alterations are within the scope of the contract and shall be provided at no extra cost to the OWNER. In the event of a major alteration resulting in a change in contract price, a change order will be issued prior to the execution of the construction work.

3.25 EXCAVATION:

3.25.1 Excavation shall be open cut with vertical sides unless in special cases the PROJECT ENGINEER shall permit sloping sides. The CONTRACTOR shall leave a berm on each side of trench to allow free passage and full working space for the PROJECT ENGINEER or his PROJECT REPRESENTATIVE.

3.25.2 The PROJECT ENGINEER shall have authority at any time to require the CONTRACTOR to discontinue use of any excavating machine or other appliance which in his judgment is not adapted to the situation in which it is being used. He may require last 4 inches in depth of excavation to be done by hand or by such machine as is acceptable to him and may forbid the use of such methods of excavation as seem likely to disturb the subgrade.

3.25.3 The CONTRACTOR shall confine his excavation to the least width that will allow the easy installation of the water main and its appurtenances; this width is here declared to be the distance between parallel vertical planes twelve (12") inches from each side of the outside of the barrel of the pipe unless the PROJECT ENGINEER shall specifically allow a greater or lesser width.

3.25.4 In case excavation is carried below grade as established by the PROJECT ENGINEER, the CONTRACTOR shall fill the bottom of excavation up to grade with suitable material and in a manner acceptable to the PROJECT ENGINEER without compensation for either the excavation or the refilling.

3.25.5 No greater length of trench shall be opened in advance of an installed, but not backfilled water main, than shall seem proper to the PROJECT ENGINEER, who will be guided by the circumstances in each case. The PROJECT ENGINEER, will at the request of the CONTRACTOR lay down a general rule to be followed but the right is reserved to the PROJECT ENGINEER to change this rule at his discretion.

3.25.6 If any stumps, roots, logs or other obstructions are encountered within the bounds of the trench, the obstruction shall be cut out to 6 inches below level of established bottom of the trench. The excess depth shall then be backfilled with good earth or aggregate, well tamped, in two layers.

3.25.7 Where there are large trees along the line of the work, large roots of these trees shall not be cut without authorization from the PROJECT ENGINEER. Wherever practicable trench shall be tunneled under such roots, which may require hand digging.

3.25.8 Excavation and piling of excavated material on lawns shall be done so as to cause the minimum of damage to shrubs and flower beds on lawns. Any damage that may result to shrubs and flower beds shall be the responsibility of the CONTRACTOR at no extra cost to OWNER.

3.25.9 Whenever pipe laying is stopped for the night, or for any other reason, the end of the pipe and openings on specials shall be closely secured with a cap or plug or otherwise to prevent the entrance of water, mud, insects, small animals or other obstructions. Unused openings shall be permanently plugged.

3.26 SHEATHING AND BRACING:

3.26.1 The CONTRACTOR must protect the sides of his trench by such shoring or bracing as may be necessary. He will be held fully responsible for all damage to property, pavement or underground structures, that may be caused by settlement or caving of the banks of the trench. No payment will be made for any shoring or bracing as such; its cost must be included in the price bid for laying water mains of such size. Sheathing Left-In-Place shall be done only after consulting with the PROJECT ENGINEER or his PROJECT REPRESENTATIVE.

3.27 FOUNDATION AND BEDDING:

3.27.1 Under average conditions, the soil at the bottom of the trench will be found to make a satisfactory foundation for the pipe. The bottom of the trench shall be leveled and pipe laid thereon. Bell holes shall be dug of sufficient size to let the whole length of the pipe barrel to be bedded as required and to allow proper assembling of joints.

3.27.2 When bottom of trench is not satisfactory for foundation, excavation shall be carried below level of established bottom of trench to a solid strata and backfilled to pipe grade with granular backfill material. Such extra excavation and backfill will be paid for at the unit price bid per cubic yard of granular backfill material.

3.28 LAYING POLYVINYL-CHLORIDE (PVC) PIPE OR POLYETHYLENE PIPE:

3.28.1 Trench width shall not exceed three (3') feet. The bottom of the trench shall be level to provide uniform bedding for the pipe. Excavate underneath pipe ends to allow pipe to rest firmly on trench foundation. Provide pumps as necessary to dewater the trench and keep the pipe essentially dry until initial backfilling has been accomplished.

3.28.2 Suitable tools and appliances for the safe and convenient handling and laying of the pipe shall be used.

3.28.3 All pipes shall be carefully examined for defects and may be subjected to extra tests as the PROJECT ENGINEER may deem necessary. If any defective pipe or specials should be discovered after having been laid, it shall be removed and replaced with a sound pipe or special without extra charge for the work or removing and replacing.

3.28.4 Caps, plugs and bends for C900 pipe shall be anchored by means of retainer glands, timber thrust block or tie rods and clamps in accordance with the details shown on the plans or other methods recommended by the manufacturer of the pipe.

3.28.5 Whenever pipe laying is stopped for the night, or for any other reason, the end of the pipe and openings on specials shall be closely secured with a cap or plug or otherwise to prevent the entrance of water, mud, insects, small animals or other obstructions. Unused openings shall be permanently plugged.

3.28.6 A blue, 4 mil, low density polyethylene tape as manufactured by New Source, Inc., Waterloo, Wisconsin, or approved equal shall be installed directly over the top center of the pipe approximately 12-inches above the pipe surface. Careful backfilling shall be required to retain tape in place during backfilling operations.

3.28.7 Tracer wire shall be a single No. 10 AWG; blue coated stranded conductor wire with UL approval direct burial insulation and shall be placed directly on top and center of the water main and service pipe. The tracer wire shall be taped to water pipe at 10-foot intervals.

3.28.8 Each mechanical joint, flanged joint, fitting, valves, restraining rods and bands shall be wrapped with a 6-mil thick polyethylene plastic wrap.

3.29 LAYING DUCTILE IRON WATERLINE:

3.29.1 All cast iron and ductile iron waterlines shall be protected by means of an 8-mil thickness polyethylene tube. Tubing shall be furnished and installed with the recommendation of the Cast Iron Pipe Research Association.

3.30 CONNECTIONS TO EXISTING WATER MAINS:

3.30.1 Work includes connections to existing water mains. Cutting-in operations shall be planned to cause a minimum of inconvenience to customers on existing mains and shall be done under the rules and regulations of the DISTRICT.

3.30.2 The CONTRACTOR shall not open or close any valve in an existing distribution system nor shall he open or close any valve set under this contract after a line has been placed in service, unless the DISTRICT has authorized him to do so.

3.30.3 Procedure for disinfecting at cut-in points shall be reviewed and approved by the DISTRICT.

3.31 THRUST RESISTORS:

3.31.1 All water mains, valves and fittings shall be blocked and/or restrained to resist thrust in conjunction with retainer glands in accordance with the manufacturer's recommendations for the individual pipe used. The cost of all labor and material required for thrust resistors shall be included in the unit price bid per foot for the water mains and fittings complete in place. Any timber used in connection with thrust blocks shall have wood preservative (pressure treatment) per AWDA Treatment C1 using water-borne ACA or CCA preservative with 0.25 percent retention.

3.31.2 Prior to backfilling, the PROJECT ENGINEER shall inspect all blocking techniques to ensure conformance with manufacturer’s recommendations.

3.32 PLUGS:

3.32.1 All fittings and discontinuous pipes shall be capped with a suitable MJ plug or cap and properly blocked. PE pipe shall have a fused cap.

3.32.2 All plugs shall be paid for by the pound as fittings unless otherwise shown on the plans. All plugs shall include thrust resistors.

3.33 BACKFILLING:

3.33.1 Backfill shall be thoroughly but carefully compacted, under and around the pipe to the spring line. Selected backfilled free of rocks or jagged material shall be carefully compacted over the top of the pipe for a depth of one (1) foot.

3.33.2 Remainder of backfilling shall be completed by filling the trench with earth firmly packed by tamping, rolling or other method approved by the PROJECT ENGINEER, so as to secure as compact a trench as possible.

3.33.3 Backfilling of trench across driveways and streets shall not be delayed pending line tests, but shall be completed immediately after line is placed. If necessary to locate leaks, joints located under this backfill shall be exposed for testing.

3.33.4 All excess excavation shall either remain the property of the OWNER and be placed and rough spread on the adjacent property, or shall become the property of the CONTRACTOR and be hauled away from the site, as directed by the PROJECT ENGINEER.

3.34 SAMPLING TAPS:

3.34.1 Sampling taps shall be installed at locations along the water main not to exceed 1,000 feet on centers, or at locations approved on the drawings.

3.34.2 The requirements for a sampling tap are as follows:

3.34.2.1 New brass faucet with no internal or external threads (vendor where these can be purchased is the USA Bluebook at (800) 548-1234 item number 45325 and 45326. No cut off faucets without adequate neck.

3.34.2.2 Faucet is facing downward.

3.34.2.3 Faucet has shut-off handle to enable collector to close valve and flame tap.

3.34.2.4 Faucet must be secured to a stake, 32 - 40 inches above the ground.

3.34.2.5 Faucet must be clean.

3.34.2.6 Sample location must be free of grass, weeds and debris.

3.34.2.7 No sample points in ditches.

3.34.3 After a satisfactory sample test report has been received, the sampling taps shall be removed and plugged at the main.

3.35 PRESSURE TESTING:

3.35.1 As the work progresses, all sections of pipe shall be tested to a minimum hydrostatic pressure of 125 pounds per square inch for a minimum period of 4 hours. If after 4 hours, the pressure drop is less than 10 psi, the test is acceptable. If after 4 hours, pressure drops to 10 psi or more, but less than 25 psi, let the test on overnight to determine what pressure the line will hold. If the pressure does not drop more than 25 psi, after 24 hours, the test is acceptable. If the pressure does drop more than 25 psi, within 24 hours, the test is not acceptable, and the line will be inspected for leaks and retested. (Any defective work revealed by the test must be repaired by the CONTRACTOR at his expense.) Test pressure shall not be exerted against a valve operated by the District. All test sections shall be sealed with plugs or caps.

3.35.2 There shall be a minimum of leakage in the lines under the stated pressure. Volume of leakage shall be determined from the quantity of water required to bring up the pressure and from direct meter readings on completed lines.

3.35.3 The entire cost of the test, including pumps, gauges, connection pipe, etc., will be made at the CONTRACTOR'S expense.

3.35.4 Potable water shall be used for testing and shall be obtained and paid for by the CONTRACTOR.

3.35.5 All hydrostatic pressure tests shall commence prior to 1:00 P.M. If the CONTRACTOR fails to reach the pressure of 125 psi by 1:00 P.M., the pressure test shall be postponed until the next regular working day.

3.35.6 CONTRACTOR shall submit to the PROJECT ENGINEER and the DISTRICT, a schedule of pressure tests which shall be revised as conditions require. The PROJECT ENGINEER and the DISTRICT shall be notified at least 24 hours in advance of the beginning of any test. It is imperative that testing be done immediately upon completion of each portion of the line. Failure to properly schedule and conduct tests will be sufficient cause for the PROJECT ENGINEER to prohibit the opening up of additional trench until all previously installed pipes and specials have been tested and all backfilling completed and work cleaned up. Work shall proceed in an orderly and expeditiously manner with all parts of the operation completion and cleaned up as the CONTRACTOR proceeds along the line.

3.35.7 The final pressure test shall be conducted against only newly installed valves; those install within one (1) year of the pressure test. The final pressure test shall be conducted with all fittings and valves in place as shown on the design plans.

3.36 STERILIZATION:

3.36.1 Procedure for disinfecting line shall be in accordance with paragraph 12:020-1 through paragraph 12:020-4, Chapter XII (Water Supplies) of the Louisiana State Sanitary Code dated March 20, 1984, or latest revision.

3.36.2 In general, after pressure tests have been made and any repairs found needed have been completed, the main shall be flushed as thoroughly as possible. When the initial flushing has been completed, pipes and all other parts of the system shall be thoroughly disinfected by the use of chlorine or chlorine compounds. The rate of application of chlorine shall be in such proportion to the rate of water entering the pipe or other appurtenances, such that the chlorine applied to the water shall be at least 50 ppm. Chlorinated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria, normally not less than 24 hours. After the chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities and at other representative points shall be at least 5 ppm. If the residual is less than 5 ppm the disinfection procedure shall be repeated until a 5-ppm residual is obtained as required above.

3.36.3 At the end of 24 hours, the main shall again be thoroughly flushed. When flushing has been completed, the main shall be refilled with system water and allowed to stand for one (1) week. Samples shall then be taken by either a private laboratory or by the DISTRICT'S laboratory. Satisfactory test results are valid for forth-five (45) days from the date of sample collection.

3.36.4 The final inspection shall occur after receipt of satisfactory sample test reports, but within 15 days of sample collection. After an acceptable final inspection, the Development/Subdivision shall be opened to the public system and local service provided.

3.36.5 After the final inspection, the Development/Subdivision shall be submitted to the DISTRICT for acceptance within forty-five (45) days of sample collection.

3.36.6 If the system has not been accepted by the DISTRICT during this forty-five (45) day period, additional flushing, sterilization and sanitary testing may be required at the expense of the OWNER.

3.36.7 Mains containing water that does not meet standards of the DISTRICT shall be again disinfected and retested.

3.36.8 No special payment will be made for disinfecting. The entire cost of water, chemicals, equipment and testing shall be included in the unit price bid for laying pipe.

3.37 VALVES

3.37.1 GENERAL:

3.37.2 Watermains 12-inch and smaller shall have gate valves.

3.37.3 All valves shall open left (counter clock-wise).

3.37.4 Upon completion of construction, all valves shall be left in the open position.

3.38 GATE VALVES:

3.38.1 Gate valves 12-inch or smaller shall be cast iron, resilient wedge, and non-rising stem with standard mechanical joint or flanged ends.

3.38.2 Gate valves shall be manufactured to AWWA C-509, Standard Specifications for Gate Valves for ordinary Waterworks Service.

3.38.3 Mueller, A2360 Series or approved equal.

3.38.4 Gate valves for hydrant supply lines shall have flanged by mechanical joint ends.

3.38.5 All interior and exterior cast iron valve bodies shall receive 10 mil fusion epoxy coating in accordance with AWWA C550.

3.39 VALVE BOXES:

3.39.1 Valve boxes for all valves shall be B & T Company, Tyler Company, or approved equal two-piece valve box.

3.39.2 Covers for valve boxes shall be round drop covers indicating "water".

3.39.3 All valve boxes shall be supplied with a centering seal.

3.39.4 The top of the installed valve box shall be flush with the surface of the finished property elevation.

3.39.5 All valve boxes shall have an 18-inch by 18-inch by 4-inch square or 18-inch round plain concrete pad poured around the valve box flush with the level of the ground. Pads may be precast and sealed in place.

3.40 FIRE HYDRANT INSTALLATION

3.40.1 FIRE HYDRANTS:

3.40.2 Fire hydrants shall meet all provisions of the current AWWA Specifications governing fire hydrants. Hydrants shall be of the “Traffic Model or Break Flange Type” so designed when the hydrant is subjected to severe impact, the special break flange ring will shear off at the ground line. Hydrant shall be constructed that it can be extended without the necessity of digging. “O” ring seals shall be used to prevent leakage.

3.40.3 All residential hydrants shall be three-way hydrants with two 2½ inch hose nozzles and one 4½ inch pump nozzle. Commercial hydrants shall have two 4½” pump nozzles. Valve opening shall be 5¼ inch.

3.40.4 Threading shall be National Standard, opening left with a 1-1/2” pentagon operating nut.

3.40.5 End inlet shall be mechanical joint with Corten, Teflon coated Corten or stainless-steel bolts and nuts.

3.40.6 The term “bury” is defined as meaning the distance from the ground line to the bottom of the pipe. Average bury is approximately three feet, six inches (3'-6”). Before ordering hydrants, the amount of bury for each hydrant location shall be determined by the CONTRACTOR. The CONTRACTOR shall furnish labor and equipment needed for locating water line and establishing amount of bury.

3.40.7 All fire hydrants shall be water-tight when subjected to a hydraulic pressure test of 300 pounds per square inch. This test shall be applied to each hydrant by the manufacturer of the hydrant and certification that each hydrant has been tested shall be stamped on each hydrant by an approved testing lab.

3.40.8 Hydrants shall be Mueller “Centurion” or approved equal.

3.40.9 One spanner wrench shall be provided for each six (6) hydrants.

3.41 INSTALLATION OF FIRE HYDRANTS:

3.41.1 All hydrants shall be constructed in accordance with the drawing entitled “Typical Hydrant Setting”.

3.41.2 All fire hydrants shall be connected to the distribution system through a 6-inch feeder valve. In those locations where the fire hydrants are being installed on an existing four-inch (4”) main, a 4-inch by 6-inch increaser shall be installed on the tee.

3.41.3 Fire hydrants shall be set on and blocked by pressure treated (See 3.12.1) timber blocks placed on a bed of 6-inches of gravel or limestone. Hydrant shall be held in place by means of galvanized pipe straps, as shown on details or installed using a mechanical joint anchoring coupling. After straps or couplings are in place the hydrant joint and water line joint shall be wrapped with 6 or 8 mil polyethylene film, lapped so as to have two layers of film in each wrapping. Film shall be taped to pipe barrel on each of side of joint. Several holes shall be punched in film to allow drainage.

3.41.4 After wrapping is in place, limestone or gravel shall be used to fill around the inlet of the hydrant to a height of three inches (3”) above the drain hole.

3.42 TAPPING SLEEVE AND VALVES:

3.42.1 When used, these shall be Mueller mechanical joint ends, or stainless-steel tapping sleeve with test plug and stainless-steel flange, Ford “SST” or approved equal.

3.42.2 All bolts and nuts used on mechanical joints shall be Corten, Teflon coated Corten or stainless steel.

3.42.3 Each mechanical and each flanged joint shall be wrapped with polyethylene film as specified for hydrant joint.

3.43 FIRE HYDRANT EXTENSIONS:

3.43.1 It is anticipated that in some locations the bury of the fire hydrant will be in excess of the standard depth specified. At these locations a fire hydrant extension shall be installed to bring the break-off of the fire hydrant above the ground level. The use of fire hydrant extensions shall be approved by PROJECT ENGINEER prior to ordering.

3.44 CUTTING INTO EXISTING LINES:

3.44.1 When it is necessary to install a fire hydrant on an existing water main, when tapping sleeves and valves are not used, the tie-in shall be made by cutting the existing water main and inserting a mechanical joint on other approved tees. The CONTRACTOR shall plan this operation in a manner that will cause a minimum interruption of water service. Cards will be prepared and delivered to residents of the area where water is to be cut off advising them when service will be cut off and the approximate duration of the interruption of service.

3.44.2 Cutting of waterlines shall be done with a hydraulic pipe cutter.

3.44.3 Fittings shall be standardized mechanical joint type and shall conform with AWWA Specifications C-110 for 250 psi working pressure (ASA A-21.10). Inside lining shall be "enamel-line" type cement lining or approved equal. Outside coating shall be coal-tar dip (ASA A21.5). Bolts and nuts shall be Corten or stainless steel.

3.44.4 When a cut is made into a water line, excavation shall be kept dry to prevent water from entering pipe and to assist in keeping pipe and fittings clean. HTH or similar chemical for disinfection shall be dusted into each fitting, each piece of pipe and each hydrant as they are installed in the system.

3.45 STERILIZATION:

3.45.1 After hydrant installation is completed, water supply valve shall be opened just enough to fill the line and bleed air from line through the hydrant. As soon as water reaches hydrant, supply valve shall be closed and chlorinated water allowed to set in the hydrant supply line for 30 minutes, after which supply valve shall be opened and line flushed through the hydrant.

3.46 BACKFILLING AND CLEANING UP:

3.46.1 Excavation for hydrant installation shall be backfilled with best available material obtained from the excavation. Backfilling shall be done in layers not over nine inches (9"), each layer being thoroughly compacted. Before final inspection all hydrant location areas shall be redressed and cleaned-up.

3.47 COLOR CODING:

3.47.1 All fire hydrants shall be painted yellow bonnet and nozzle caps of the hydrant shall be color coded according to the measured flow from the hydrant. Color coding shall be as follows:

FLOW RANGE	COLOR CODE
Less than 500 GPM	Red (1210 Rust-O-Leum)
501 - 1,000 GPM	Yellow (659 Rust-O-Leum)
More than 1,000 GPM	Green (1282 Rust-O-Leum)

3.47.2 CONTRACTOR shall coordinate flow testing with fire company representative of DISTRICT where hydrant is being installed.

3.48 MEASUREMENTS AND PAYMENTS

3.48.1 GENERAL:

3.48.2 General contracts for waterlines are unit price contracts and all quantities are approximate quantities. The CONTRACTOR'S attention is directed to the items of work for which no payment item has been established. All work shown on the drawings and outlined in the specifications is to be completed in all respects, and the cost of all miscellaneous and associated work is to be included in the unit prices bid for the various items that payment items have been established for.

3.48.3 All quantities shall be measured and tabulated by both the PROJECT ENGINEER and CONTRACTOR. Requests for payment and supporting data shall be prepared by the CONTRACTOR and given to the PROJECT ENGINEER sufficiently in advance of payment date to permit thorough checking of all quantities.

3.48.4 CONTRACTOR shall submit a daily report and daily sketch sheet showing lines, fittings, valves, taps, etc., installed with sufficient data to accurately locate these items after trench has been backfilled.

3.48.5 The CONTRACTOR shall furnish the PROJECT ENGINEER whatever assistance is required, laborers, clerks and records that will enable the PROJECT ENGINEER to expeditiously check all estimates and especially the final “Record Drawing” quantities of the project.

END OF SECTION 3

SECTION 4 SEWER SYSTEM

4.1 GENERAL

4.1.1 All pipe, including specials and fittings used for the construction of gravity sewers shall be Poly Vinyl Chloride.

4.2 SEWER PIPE

4.2.1 Solid Wall P.V.C. Pipe and Fitting shall conform to A.S.T.M. Designation D-3034 latest edition. Sewer pipe to be installed per D2321, latest edition.

4.2.2 The CONTRACTOR must furnish a certificate from the manufacturer that the pipe furnished by him does conform thereto and to the requirements of these specifications and that it has been tested according to A.S.T.M. specifications by a testing laboratory of recognized standing. Wherever the word "pipe" is used in these specifications shall be interpreted as also referring to T's, Y's and other fittings, unless the shape of the fitting shall make the matter plainly applicable. Each pipe approved by the said testing lab shall be plainly marked by the INSPECTOR with the mark of the lab. The cost of all inspection and testing must be included in the prices bid for sewer pipe laid.

4.2.3 In addition to the lab tests all pipe and fittings will be subjected to a rigid inspection after delivery on the site of the work and just before being laid in the trench and those found to be defective in any way will be rejected and must be removed from the work.

4.3 PIPE SPECIALS

4.3.1 Specials, as tees, elbows and Y branches shall conform to the requirements of the applicable American Society for Testing Materials Specifications. Specials for house services shall be 6 inches in diameter and placed as shown in the plans or as ordered during construction. All 6-inch openings shall be plugged with a disc fitting the bell snugly. Disc shall be so designed and jointed as to be substantially water tight under service conditions, but removable without substantial risk to the pipe bell.

4.4 SEWER PIPE JOINTS

4.4.1 Pipe shall have factory-formed joints complying with A.S.T.M. designation C-425-60T, as revised.

4.4.2 O-ring gaskets, if used, shall be as per US Rubber Company Bulletin 834, 1961.

4.5 LINES AND GRADES

4.5.1 All sewers shall be laid to grade and elevation as shown on the plans or as notified on account of unforeseen conditions. Cut sheets will be furnished by the CONTRACTOR to the ENGINEER for approval, and these, in conjunction with the stakes, hubs and markers set by the CONTRACTOR shall be used to determine the location and elevation of all sewer pipes.

4.5.2 The CONTRACTOR shall submit cut sheets to the ENGINEER 24 hours in advance of beginning work on any section of the line. In this connection, the CONTRACTOR shall submit to the schedule of current week. This schedule shall be based on actual progress and shall be revised each week to make the planned schedule conform closely to actual schedule.

4.6 CHECKING LINES AND GRADES

4.6.1 All lines and grades approved by the ENGINEER shall be checked by the CONTRACTOR by "lining ahead" sufficiently in time to permit the ENGINEER to make any adjustments found necessary. At least four batter boards or grade boards shall at all times be set and checked for straight line grade in advance of laying any sewer pipe. The CONTRACTOR shall not attempt to adjust any error in grade found but shall immediately notify the ENGINEER who will have the correction made.

4.6.2 A reference benchmark shall be established by the CONTRACTOR'S instrument man at each junction manhole. Prior to acceptance of the work, check levels shall be run on each manhole invert, said work being done by the CONTRACTOR'S instrument man and recorded by the ENGINEER or his representative.

4.7 PROTECTION OF WATER AND GAS MAINS, STORM DRAINS, AND SUBSURFACE STRUCTURES

4.7.1 All water pipes, gas lines, telephone conduits, storm water drains, and other subsurface structures shall be properly supported and protected during and after construction and repaired or replaced if necessary and left in as good condition as before work started. The cost of substructure protection, replacement and repair shall be included in the price bid on other items.

4.8 EXCAVATION

4.8.1 Excavation shall be open cuts with vertical sides unless in special cases the ENGINEER shall permit tunnels or sloping sides. If tunnels are authorized by the ENGINEER, they shall be of the same width throughout as open cuttings and of sufficient height to allow a grade line to be stretched parallel with the flow line of the pipe and in the clear above the crown of the pipe.

4.8.2 The CONTRACTOR shall leave a berm at least two (2) feet in width on each side of the trench, between the trench and the spoil bank, to allow for free passage of the ENGINEER or INSPECTOR and to permit the INSPECTOR to perform his work in an expeditious and satisfactory manner.

4.8.3 The CONTRACTOR shall confine his excavation to the least width that will allow easy installation of the sewer and its appurtenances; in any case where quantities of pavement or of additional excavation are involved and the cost to the OWNER is affected, the ENGINEER will set a maximum width beyond which the CONTRACTOR may not go without bearing the whole cost of the additional excavation and of the extra pavement or other surface improvement involved.

4.8.4 In case the excavation for any structure is carried below the grade established by the ENGINEER, the CONTRACTOR shall fill the bottom of the excavation up to grade with suitable material and in a manner acceptable to the ENGINEER without compensation for either the excavation or the backfilling.

4.9 PERMISSIBLE LENGTH OF OPEN TRENCH

4.9.1 The length of trench to be opened or the area of the surface to be disturbed or restored to its original condition at any one time shall be limited by the ENGINEER with regard both to expeditious construction and to the convenience and comfort of business houses and persons residing in the neighborhood or frequently the streets in question.

4.9.2 New trenching will not be permitted when earlier trenches need backfilling or labor is needed to restore the surface of the street to a safe and proper condition. The ENGINEER will refuse additional lines and grades for new trenches should the CONTRACTOR fail to meet the requirements herein specified as to backfilling and resurfacing.

4.9.3 The "length of trench" is herewith defined as the maximum distance from the point where the backfilling and resurfacing is completed and in proper condition for traffic, to the point where the surface has been disturbed and unsafe for traffic.

4.10 SHEETING AND BRACING

4.10.1 The CONTRACTOR must protect the sides of his trench by such shoring or bracing as is necessary to make the trench secure from caving. He will be held fully responsible for all damage to persons, property, pavement, or underground structures that may be caused by settlement or caving of the banks of the trench. No payment will be made for any temporary shoring or bracing, as such; its cost must be included in the unit prices for bid for pipe.

4.10.2 When in the judgment of the ENGINEER removal of shoring or bracing either or both, is likely to cause damage of pavement or property, the ENGINEER may order such shoring or bracing as he considers necessary left in place and the CONTRACTOR shall be entitled to compensation therefor. Neither the giving of such orders by the ENGINEER nor his failure or refusal to issue such orders shall in any way relieve the CONTRACTOR of responsibility for damages to pavement, buildings, etc.

4.10.3 Sheeting shall not be driven down below the centerline of a sewer pipe without special permission from the ENGINEER. Sheeting driven below the centerline of the pipe without special permission shall not be removed and will not be paid for.

4.10.4 Any upper sheeting left in place must be cut off at least two (2') feet below the ground surface after backfilling and tamping has reached this level and all rangers and braces above this level must be removed.

4.10.5 If the CONTRACTOR wished to use steel sheeting, either interlocked or driven as separate units, he shall make request of the ENGINEER for permission and the ENGINEER will prescribe conditions and methods under which the CONTRACTOR may drive steel sheeting and pull it out again, unless the ENGINEER shall consider such action undesirable under the governing circumstances.

4.10.6 Except as stated in Paragraph (b) above, sheet piling, sheeting, bracing, or shoring of any type will not be paid for as such, its cost must be absorbed in the prices of items on which bids are asked in the Form of Proposal.

4.11 BEDDING OF SEWER PIPES

4.11.1 The bedding of the sewer pipe, whether in the natural soil or on artificial foundation, and the widths of the trenches are factors of strength of the sewer that have been taken into consideration in its design. The spacing of sheeting and bracing and the bedding of planking and shells must therefore conform closely to the requirements of the specifications and the drawing illustration the use of foundation materials, etc.

4.12 FOUNDATION

4.12.1 The ENGINEER will order the use of special foundation under pipe sewers where he considers it necessary.

4.12.2 Lumber used as foundation under pipe sewers, where it is laid longitudinally or laid transversely on the bottom of the trench or laid transversely or rangers as shown on the drawings, will be paid for as Foundation Lumber under Sewers.

4.12.3 The bedding material, which is usually clam shells or shell concrete shall be laid on the planking at the points designated by the ENGINEER and to such depths under and around the sewers, as he may require. The location and the quantities of all foundation materials under the pipe sewers, except the standard shell base, shall be at the direction of the ENGINEER and payment will be for such quantities, in place, at the prices bid.

4.12.4 The standard lumber for use as foundation for sewers, manholes, etc., shall be No. 2 Common Southern Short Leaf Yellow Pine; if substitutes are offered, they must meet with the approval of the ENGINEER.

4.12.5 The cost of cutting, placing, and fastening any lumber in sheeting, bracing, foundation, or elsewhere, including the nails, spikes, etc., used as fastenings, shall be absorbed in the cost of the lumber itself whether this lumber is paid for at a bid price or be included in the price of some other item.

4.13 REMOVAL OF WATER

4.13.1 The CONTRACTOR shall place on the job and shall maintain with each house connection crew at least 3 diaphragm pumps in good mechanical and operating condition. Failure of the CONTRACTOR to provide and maintain this minimum number of pumps per crew will constitute a violation of this contract. Previous experience on sewer construction in this vicinity makes this provision an essential part of this contract in order to enable the CONTRACTOR to work efficiently as well as to assure the quality of work expected under this contract.

4.13.2 The CONTRACTOR shall at all times during construction provide and maintain means and devices with which to promptly dispose of all water entering the excavations or other parts of the work and shall keep said excavations dry until the structures to be built therein are completed. No masonry shall be laid in water nor shall water be allowed to rise over masonry if there is danger of flotation or of setting up unequal pressures in the concrete, until the concrete has set up at least 24 hours and any danger of flotation has been removed. In water bearing sand or quicksand, suitable equipment of well points and/or sheeting shall be supplied with pump and other appurtenances of ample capacity to keep a dry excavation as specified.

4.13.3 Well point system selected by the CONTRACTOR shall be approved for use by the ENGINEER. The CONTRACTOR shall have analyses made of local sands and the manufacturer of well point equipment shall furnish the ENGINEER with satisfactory evidence that screens of this well points are the correct size to restrain these sands without becoming clogged up.

4.13.4 All well points shall be placed at least 3 feet away from the barrel of the pipe.

4.13.5 Drain wells may be required to dewater areas in which strata of water bearing sands are separated by lenses of impervious clay. These wells shall be made by cutting a hole of sufficient size through the impervious strata and installing a well point or points in a gravel well.

4.13.6 The CONTRACTOR shall dispose of water from the work in a suitable manner without damage to adjacent property or sewers. No water shall be drained into work built or under construction.

4.13.7 During the laying of sewers and until sewer pipe has finally bedded in place with at least two feet of backfill over the pipe, the CONTRACTOR shall keep the ground water plane below the bottom of the trench.

4.13.8 No sewer will be permitted to be laid except in a dry trench. Running water shall be completely blocked off by dewatering and/or sheeting, and no sewer shall be laid in a trench which sand is flowing into. The trench must be dry and clean to assure that the hub and spigot of the pipe are perfectly dry before a joint is made.

4.13.9 All removal and handling of water required to maintain dry trenches or other excavations for the construction of sewer or other structures in the dry shall be at the expense of the CONTRACTOR.

4.14 BACKFILLING - TAMPING

4.14.1 All trenches or excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown and directed.

4.14.2 In backfilling sewer or other pipe trenches, no large stone, broken concrete, roots, timber, etc., shall be placed in the backfill. The backfilling around and over the pipe shall be carefully done by hand and tamped with suitable tools of approved weight to a point two (2') feet above the top of the pipe. This material shall be placed in layers approximately six (6") inches thick, each layer being thoroughly tamped and compacted in place.

4.14.3 When the backfill is mostly sand, the well points shall be kept in operation and the backfill drenched but not flooded with water to thorough compaction. Drenching the fill and operations of well points shall continue until the ENGINEER advises the CONTRACTOR that he has accepted the backfill and is ready to inspect the sewer line for leaks as hereinafter specified.

4.14.4 When the backfill is mostly clay, the backfill to a point of two feet (2') above top of pipe shall be best material available from trench excavation at point being worked. Clay backfills shall not be drenched or flooded.

4.14.5 The remainder of backfilling shall be completed after sewer lines have been tested. Backfilling shall be done in layers not to exceed one foot (1') in thickness. In no case will backfilling material from a bucket be allowed to fall directly on a sewer and in all cases the bucket must be lowered so that the shock of falling earth will not damage the sewer structures. All backfilling will be carried on as speedily as possible.

4.14.6 After each portion of the backfilling has been completed as specified herein, it shall be allowed to stand for such period of time as the ENGINEER may direct, but no longer than two (2) months. Immediately after the expiration of this time the CONTRACTOR shall gather up and remove all surplus material lying above the original surface of the ground and shall dispose of this material in a satisfactory manner at his own expense. He shall thoroughly clean the whole site of the work, make all repairs or replacements and leave the whole line of his work in a condition satisfactory to the ENGINEER.

4.14.7 In backfilling around concrete or other structures, all lumber, rubbish, braces, and refuse shall be removed from behind the walls before backfilling is started. Backfilling shall be made in a manner to prevent after-settlement, be tamped or wet down, and left at proper grade and with a smooth even surface.

4.15 DISPOSAL OF SURPLUS

4.15.1 All surplus dirt shall be hauled and disposed of on the adjacent property belonging to the OWNER.

4.16 LAYING OF SEWERS

4.16.1 All sewer pipes and specials shall be carefully inspected before being laid and no cracked, broken and/or defective pipe or specials shall be used in the work. Each piece of pipe shall be sounded before being placed in line.

4.16.2 The pipes and fittings shall be so laid in the trench that after the sewer is completed the invert thereof shall conform accurately to the grades and alignment established by the ENGINEER. At any stage of construction of a straight stretch between two consecutive manholes, the zero or starting end of the pipe shall be clearly visible on looking through the pipe in clear view.

4.16.3 Depression shall be left in the shell foundation for each bell and be of such depth to insure proper and satisfactory bearing along the entire length of each pipe and to allow sufficient space for making joints properly. Bell holes shall be no larger than needed for making up joint.

4.16.4 After the pipe has been laid, the best material available from excavation in the immediate vicinity of where the pipe is being laid shall be used to backfill around and over the pipe.

4.17 MAKING SEWER JOINTS

4.17.1 Pipe joints shall be factory made except where approved by the ENGINEER. During laying of the pipe, if necessary, the manufacturer shall send a qualified representative to the job to properly instruct the CONTRACTOR'S forces in procedure for making up joints and to ascertain the suitability of the joint for installation for job conditions. It is mandatory that during the instruction period, the manufacturer advise the CONTRACTOR and the ENGINEER of any job condition that may cause the joint to leak.

4.17.2 Each newly made joint will be inspected and if it is not found to be satisfactory the last laid length of pipe shall be removed at once. The bell of the preceding pipe shall be thoroughly cleaned, a fresh pipe shall be used for the new length and the joint shall not be re-laid until the spigot has been thoroughly cleaned.

4.17.3 Whenever pipe laying is stopped, whether for the night or for any other cause, the end of the pipe shall be securely closed to prevent the entrance of water, mud or other matter, and shall be secured in such a manner as to prevent the end pipe from being dislodged by any sliding or other movement of backfilling.

4.18 BRANCH LINES - TEES

4.18.1 Tees for the reception of house connections shall be built into pipe sewers at locations designated on the plans or by the ENGINEER.

4.19 RISERS

4.19.1 Risers consisting of six (6") inch sewer pipe and specials surrounded by concrete as shown on the plans, shall be built on the sewer where ordered by the ENGINEER. Care should be taken to surround and support the pipes thoroughly by concrete or masonry and to keep the interior of the pipe and specials clean and free from obstructions.

4.20 SEWER HOUSE CONNECTIONS

4.20.1 The CONTRACTOR shall lay six-inch (6") sewer pipe house connections from tee openings in the sewers to such points near the property lines as is designated by the ENGINEER. The standard connection will have a depth of not exceeding five feet (5') at the curb line and not exceeding seven feet (7') at the sewer, these depths measured from the house connection pipe. Excavation shall be included in the price bid per linear foot.

4.20.2 The price bid per linear foot for sewer house connections shall include excavation to the standard depths stated above bracing the trench, the tee in sewer mains, furnishing and placing the pipes and all fittings indicated in the drawings, furnishing the jointing materials and making the joints, backfilling and tamping the trench, cleaning up and removing surplus earth and waste materials; in completed installation of the house connections.

4.20.3 Payment for house connections will be made by horizontal measurements over the center of the connection, from the center of the sewer to the shoulder in the bell of the last pipe or fitting; payment for side branches out of the connection will be made the same way, by horizontal measurement, from the center of the main connection to the end of the laying length of the last pipe or fitting of the branch. The unused branches or fittings out of which future connections may be measured and paid for, only the used branch is covered by this paragraph. The CONTRACTOR shall furnish and set in sewer line a T-branch out of which shall be included in the price bid for sewer connections. If vertical pipe is needed to raise this tee to the proper height for sewer house connections, the length of vertical pipe used will be considered as riser pipe and will be paid for as such.

4.20.4 All unused openings in sewer house connections shall be closed with caps or plugs of same material as the pipe. Caps and plugs shall be held in place by other means than the joint material. Caps will be so designed and jointed as to be substantially water tight under service conditions, but removable without substantial risk of damage to the pipe bell. No special payment will be allowed for these caps and plugs and the fastenings, as the cost shall be included in the price bid for house connection pipe.

4.20.5 Foundation material for extra concrete ordered by the ENGINEER will be paid for at the prices bid for these items. The ENGINEER shall order the installation of any fittings, which are not indicated by the plans. The said fittings shall be furnished and installed and will be paid for as extra work, no deduction will be made for the cost of any straight pipes replaced by these extra fittings.

4.20.6 Joints in sewer house connections shall be made with the same material and in the same manner as is required for joints in sewers.

4.20.7 Sewer service marking shall consist of the placement of magnetic marking tape or 1 - #4 deformed bar, 12” in length and a 1” x 1” wood stake painted green or marked with green flagging at the end of the service.

4.21 PLUGS

4.21.1 T-branches and risers not extended to property lines by house connection sewers shall be plugged with scored discs. The discs shall be held firmly in the socket and shall be seated in a manner to prevent blowout in the event of flooding of the sewer line.

4.22 MARKING BRANCH OPENINGS

4.22.1 Every branch opening shall be marked by a 1" X 2" cypress or creosoted pine strip not less than four feet (4') long, set vertical in the backfill, over the opening and reaching to within one foot (1') of the ground surface.

4.23 BULKHEADS

4.23.1 The CONTRACTOR shall build inside the sewer, constructed under the contract suitable brick bulkheads to protect his work against the entrance of dirt or water and also to protect adjacent work built under another contract.

4.23.2 These bulkheads shall be constructed at such points and in such manner as ordered and directed by the ENGINEER, and when so ordered, they shall be removed by the CONTRACTOR. Prior to removal of such bulkhead, or prior to the joining up of adjacent work to the work built under the contract, the CONTRACTOR shall at his own expense remove all water which has collected behind such bulkheads and which may in any way affect their satisfactory removal or interference with adjoining work.

4.24 MANHOLES

4.24.1 Under this specification, the CONTRACTOR shall construct manholes in accordance with the Sewer Detail Sheet as attached to the Construction Plans or their approved alternate. The CONTRACTOR shall obtain from the ENGINEER, in writing, approval to substitute an alternate design prior to construction of manholes.

4.25 SEWER INSPECTION AND TESTS

4.25.1 Inspection and tests will be made by the ENGINEER at regular intervals as the work progresses to determine that the quality of workmanship specified herein is being obtained.

4.25.2 Certain limits of infiltration are set up, but these limits are applicable only after a manhole to manhole inspection has been made to eliminate all detectable leaks.

4.25.3 It is imperative that all sewers and manholes be built practically watertight and that the CONTRACTOR must adhere rigidly to the specifications for material and workmanship. All of the sewage must be pumped and special care and attention must be paid to securing watertight construction. After completion, the sewers, or sections therefore, will be tested and gauged and if the infiltration (leakage into sewer) is above allowable limits specified, the sewer will be rejected.

4.25.4 When backfilling has been completed sufficiently to prevent sewer pipe from floating, water shall be allowed to rise in the trench and before de-watering equipment is removed, the sections of sewer shall be tested for infiltration. If well points are used well points system shall not be disconnected until section of sewer has been approved in writing by the ENGINEER.

4.25.5 The allowable limit of ground water infiltration (leakage into sewer) for any one or more sections of sewer shall not exceed the following limits of infiltration rates for full acceptance: 200 gallons per inch diameter per 24 hr. day per mile of sewer for all depths of cut.

4.25.6 Tests shall be made before existing sewers and sewer flow are allowed into the sewer. The ground water infiltration will be measured by means of a V-notch weir, or by measuring the volume direct. All expense of above test or tests shall be borne by the CONTRACTOR and be included in the unit prices bid per foot of sewer under each respective size and excavation cut of sewer.

4.25.7 Any defects of whatever kind found in the system shall be made good at the expense of the CONTRACTOR.

4.25.8 On completion of a section, sewer is to be cleaned and inspected and all repairs shown necessary by the test are to be made; broken, or cracked pipe replaced, all deposits removed, the sewer left true to line and grade entirely clean, free from protruding joint material and ready for use. Each section of sewer between manhole is to show from either end on examination a full circle of light.

4.25.9 As the work progresses, all sections of sewer force main pipe shall be tested to a hydrostatic pressure of 125 pounds per square inch for a minimum period of four hours. If in four hours pressure drops to 115 psi, let test on overnight to determine what pressure the line will hold. If pressure does drop below 100 psi after twenty-four hours, the test is not acceptable, and the line will be inspected for leaks and retested. Any defective work revealed by the test must be repaired by the CONTRACTOR at his expense. Test pressure shall not be exerted against a valve. All test sections shall be sealed with plugs or caps.

There shall be a minimum of leakage in the lines under the stated pressure. Volume of leakage shall be determined from the quantity of water required to bring up the pressure and from direct meter readings on completed lines.

The entire cost of the test, including pumps, gauges, connection pipe, etc., will be made at the CONTRACTOR'S expense.

Potable water shall be used for testing and shall be obtained and paid for by the CONTRACTOR.

CONTRACTOR shall submit to the ENGINEER a schedule of pressure tests, which shall be revised, as conditions require. The ENGINEER shall be notified at least four hours in advance of the beginning of the test. It is imperative that testing be done immediately upon completion of each portion of the line. Failure to properly schedule and conduct tests will be sufficient cause for the ENGINEER to prohibit the opening up of additional trench until all previously installed pipe and specials have been tested and all backfilling completed and work cleaned up. Work shall proceed in an orderly and expeditious manner with all parts of the operation completed and cleaned up as the CONTRACTOR proceeds along the line.

4.26 MEASUREMENTS AND PAYMENTS

4.26.1 General contracts for sanitary sewerage extensions are unit price contracts and all quantities are approximate quantities. The location and grade of lines shown on the plans have been determined as accurately as possible. Should underground obstructions require the lowering of any sewer line, the extra work involved will be paid for only on the basis of the bracket cut in which the depth of sewer line falls. No claim will be accepted from the CONTRACTOR that the average depth of cut within any bracket as built is greater than that shown on the plans, nor will any credit be required if the average depth of cut within any bracket is less than shown on the plans.

4.26.2 The CONTRACTOR'S attention is directed to the items of work for which no unit price is set. All work shown on the plans and outlined in the specifications is to be completed in all respects and the cost of the work is to be included in the unit price bid for the various classes of work.

4.26.3 Measurement: Length of lines will be measured from center to center of manhole. Depth of cut will be determined from the offset stakes rather than from centerline profiles. Change in depth of cut from one bracket to another will be computed by interpolation between stations on cut sheets and not by field measurements. The unit price specified to be paid per foot for each

respective size of sewer pipe is payment in full and includes the work defined under excavation, backfilling, and grading; the complete restoration of ditches, streets, and shoulders as outlined; the reconnecting all existing sewers along each section of sewer; protection and care of all existing and underground structures in the line of the work, trenching and trimming, removal of sheath, refilling of all unauthorized excavation, tamping, fill; disposal of surplus dirt; de-watering trench and handling of all water, materials as selected for pipe; joints, sewer inspection and testing; all as herein specified under the various headings.

4.26.4 Payment per unit will include all bends, pipe, plug and sewer service marker from the tee branch in the sewer line to the end of the house connection.

4.26.5 8" sewer cleanouts will be placed at the end of a sewer line or in a six-inch (6") house connection branch line and will be measured as a unit and paid under 8" Sewer Cleanout which will include wye, concrete foundation under wye in sewer or house connection, eighth bend, riser pipe, plug, and cast-iron cleanout cover set in a concrete ring.

END OF SECTION 4

11 March 2022

Terrebonne General Health System
c/o Rozas Ward Architects, APC
Suite 3550
1100 Poydras Street
New Orleans, Louisiana 70163

Attention Mr. Jared Reynolds
PN 1-504-524-4375, Extension 710
Email Jared@rozas-ward.com

Ladies and Gentlemen:

Geotechnical Exploration
Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925
Eustis Engineering Project No. 24717

Transmitted is an electronic copy of our engineering report covering a geotechnical exploration for the subject project. A hard copy is available upon request.

Thank you for asking us to perform these services.

Yours very truly,

EUSTIS ENGINEERING L.L.C.

STATE OF LOUISIANA
PATRICK A. THURMOND
License No. 44237
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

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GEOTECHNICAL EXPLORATION

TERREBONNE GENERAL MEDICAL CENTER

PROPOSED HEALTH AND WELLNESS CENTER

HOUMA, LOUISIANA

SEF PROJECT NO. 6925

EUSTIS ENGINEERING PROJECT NO. 24717

FOR
TERREBONNE GENERAL HEALTH SYSTEM
HOUMA, LOUISIANA

ROZAS WARD ARCHITECTS, APC
NEW ORLEANS, LOUISIANA

BY

EUSTIS
ENGINEERING L.L.C.
SINCE 1946

METAIRIE, LOUISIANA

11 MARCH 2022

TABLE OF CONTENTS

INTRODUCTION 1
SCOPE OF SERVICE 1
FIELD EXPLORATION 2
General 2
Soil Borings 3
Cone Penetration Tests 4
LABORATORY TESTS 4
DESCRIPTION OF EXISTING SITE CONDITIONS 5
Site Observations 5
Stratigraphy 5
Groundwater 6
ENGINEERING ASSESSMENT AND RECOMMENDATIONS 7
Furnished Information 7
Foundation Recommendations 7
Groundwater Management 9
Site Preparation 10
Fill Settlement 12
Areal Subsidence 13
In-Situ Properties 14
Deep Foundations 14
Installation of Driven Piles 20
Installation of Auger Cast-in-Place Piles 22
Integrity Testing for Auger Cast-in-Place Piles 25
Test Piles and Load Tests 26
Pavements 28
Vibrations 31
GEOTECHNICAL SERVICES DURING CONSTRUCTION 33
LIMITATIONS 34

TABLE OF CONTENTS (CONTINUED)

FIGURES

Figure 1	Site Vicinity May
Figure 2	Boring and CPT Location Plan
Figure 3	Estimates of Allowable Single Pile Load Capacities, Treated ASTM D25 Quality Timber Piles
Figure 4	Estimated Allowable Single Pile Load Capacities, Augered Cast-in-Place Concrete Piles
Figure 5	Pile Group Capacity and Spacing

APPENDICES

Appendix I	Boring Logs and Laboratory Test Results
Appendix II	Cone Penetration Test Records
Appendix III	Furnished Site Layout Drawing

GEOTECHNICAL EXPLORATION
TERREBONNE GENERAL MEDICAL CENTER
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA
SEF PROJECT NO. 6925
EUSTIS ENGINEERING PROJECT NO. 24717

INTRODUCTION

1. This report contains the results of a geotechnical exploration performed for the proposed health and wellness facility for Terrebonne General Medical Center (TGMC) to be located in Houma, Louisiana. We provide a site vicinity map on Figure 1. The exploration was performed in general accordance with the alternate scope of work presented in Eustis Engineering L.L.C.'s revised proposal, dated 13 December 2021, which was authorized on 21 December 2021 by Ms. Diane Yeates, Chief Operating Officer of Terrebonne General Health System, the project owner. The project architect is Rozas Ward Architects, APC (Rozas Ward). The site civil engineer and structural engineer for the project are Milford & Associates, Inc. (Milford) and Schrenk Endom & Flanagan L.L.C. (SEF), respectively.

SCOPE OF SERVICE

2. The exploration included the drilling of three undisturbed sample-type soil borings and the performance of three cone penetration tests (CPTs) to determine subsoil conditions and stratification and to obtain samples of the various strata encountered. Soil mechanics laboratory tests, performed on samples obtained from the borings, were used

to evaluate the physical properties of the subsurface soils. Engineering analyses, based on the soil borings, laboratory tests, and CPT data, were performed to determine recommendations regarding site preparation and drainage, subsoil and groundwater conditions, placement and compaction of fill material, near-surface soil shrink/swell potential, estimates of allowable vertical pile load capacities, pile installation and testing methods, estimates of settlement, and recommendations for components and thicknesses for flexible and rigid pavements. General foundation construction recommendations are also provided. Additional laboratory testing to support a lime/soil-cement stabilization study was removed from our scope of service by agreement of Eustis Engineering, Milford, and Rozas Ward based on the results of the geotechnical exploration.

FIELD EXPLORATION

General

3. Three soil borings were drilled at the project site. The deepest boring, designated as B-1, was drilled on 27 January 2022 to a depth of approximately 100 feet below the existing ground surface. Two additional borings, designated as B-2 and B-3, were drilled on 28 and 31 January 2022 to an approximate depth of 80 feet each below the ground surface. Three CPTs were performed on 31 January 2022 to approximate depths of 80 feet below the ground surface using a track-mounted rig. The approximate location of the borings and CPTs are shown on Figure 2. Detailed descriptive logs of the borings are presented in both tabular and graphical form in Appendix I. Records of the CPT soundings are plotted graphically with depth and are provided in Appendix II. Approximate GPS coordinates for each exploratory location were obtained with a handheld device and

should be considered approximate. These coordinates are shown in terms of latitude and longitude on the boring logs and CPT records in Appendices I and II, respectively. Upon completion of field operations, the boring/CPT holes were grouted with cement bentonite grout mix and backfilled with soil in accordance with current regulatory requirements by the State of Louisiana.

Soil Borings

4. The undisturbed sample-type soil borings were drilled using a truck-mounted rotary-type drill rig. Samples of cohesive or semi-cohesive subsoils were obtained at close intervals or changes in stratum using a 3-in. diameter by 30-in. long thinwall Shelby tube sampling barrel (ASTM D1587). The samples were extruded from the sampling barrel in the field, inspected, and visually classified by Eustis Engineering's soil technician. Pocket penetrometer tests were performed on the soil samples to give a general indication of their shear strength or consistency. The results of these tests are shown on the boring logs under the column heading "PP." Representative samples were then promptly placed in moistureproof containers for transportation to our laboratory.

5. Samples of cohesionless and semi-cohesive materials were obtained during the performance of in-situ Standard Penetration Tests. These tests consist of driving a 2-in. diameter sampler 1 foot into the soil after first seating it 6 inches. A 140-lb weight dropped 30 inches is used to advance the sampler. The number of blows required to drive the sampler is indicative of the relative density of cohesionless soils and the consistency of cohesive soils. The samples were retained in moistureproof containers for preservation of their natural moisture content. The results of the Standard Penetration Tests are shown on the boring logs under the column heading "SPT."

Cone Penetration Tests

6. The CPTs were performed with a track-mounted rig using an electronic piezocone penetrometer having a 5-ton capacity and a net area ratio of 0.850. Testing was performed in general accordance with methods and procedures outlined in ASTM D5778-20. The CPTs were performed using a 10-cm^2 cross-sectional area cone with a 60° apex angled tip and 150-cm^2 sleeve area. The penetrometer was hydraulically advanced into the ground at an approximate rate of 2 cm/sec. During piezocone testing, CPT parameters (tip resistance, friction resistance, and pore pressure) were recorded at 2-cm depth intervals. In Appendix II, the CPT plots present the measured tip resistance (q_t), sleeve friction (f_s), and pore pressure (u_2). The estimated undrained shear strength (S_u), equivalent standard penetration resistance (N_{60}), and interpreted soil behavior type (SBT) are also provided on the CPT records.

7. Undrained shear strength estimates and estimated standard penetration resistances are interpreted from correlations developed by Lunne, Robertson and Powell (1997 and 1986) and our engineering experience in southern Louisiana. The interpreted SBT is determined according to the non-normalized friction-ratio based soil behavior chart established by Robertson and Campanella (1986). Please refer to the cone penetration test correlation document following the CPT records in Appendix II for additional information.

LABORATORY TESTS

8. Soil mechanics laboratory tests, consisting of natural water content, unit weight, unconfined compression shear (UC), and unconsolidated undrained triaxial compression

shear (OB), were performed on selected samples obtained from the borings. In addition, Atterberg liquid limits (LL) and plastic limits (PL) tests were performed on selected representative samples to aid in classification and determination of relative strength and compressibility of the subsurface soils. The results of these laboratory tests are provided on the boring logs in Appendix I.

DESCRIPTION OF EXISTING SITE CONDITIONS

Site Observations

9. The project site is located approximately 1,200 feet north of the intersection of Westside Boulevard Extension and Enterprise Drive in Houma, Louisiana. During field operations, the site consisted of predominantly cleared pastures with intermittent drainage swales. The project area is bounded to the north by a pond appearing to serve as a detention/drainage area for the development area.

Stratigraphy

10. Our interpretation of the stratigraphy at each boring location is shown on the logs in Appendix I. CPT records of encountered SBT are provided graphically in Appendix II. Review of the boring logs indicates near-surface deposits at the boring locations included very soft to medium stiff gray, tan, and brown fat clay that extended approximately 9 to 16 feet below the existing ground surface. Next in the stratigraphy, loose to medium dense sandy silt, silty sand, and fine sand were encountered to approximately 25.5 to 33.5 feet below the ground surface and were underlain by a stratum of soft to medium stiff gray and brown organic clay in Borings B-1 and B-3 between the 27 and 32-ft depths.

Below the 32 to 33.5-ft depths, materials encountered predominantly consisted of soft to medium stiff gray fat clay with isolated strata of lean clay to the terminal depth of the exploration, approximately 100 feet below the existing ground surface. An exception to this general stratigraphy included medium stiff gray and brown organic clay encountered in Boring B-3 between depths of 48 and 62 feet below the existing ground surface. The SBTs presented on the CPT records provide general agreement with the stratigraphy observed in the borings.

Groundwater

11. To estimate groundwater conditions at the time of the field exploration, observations were made in auger borings drilled near Boring B-1 and in Boring B-2. The auger borings near Boring B-1 and in Boring B-2 were drilled without the addition of water or drilling fluids to depths where free water was initially encountered approximately 9 and 5 feet, respectively, below the existing ground surface. After observational periods of 24 hours at Boring B-1 and 15 minutes at Boring B-2, free water was observed in both bore holes at a depth of approximately 4 feet below the existing ground surface. The depth to groundwater will vary with climatic conditions, local drainage improvements, water levels in the nearby pond, onsite construction activities, and other factors. For this reason, the depth to groundwater should be determined by those persons responsible for construction immediately prior to beginning work.

ENGINEERING ASSESSMENT AND RECOMMENDATIONS

Furnished Information

12. A conceptual layout furnished by Rozas Ward indicates major project features will include the proposed health and wellness center building, parking lot, and an exercising field. We present this furnished drawing in Appendix III. We understand the proposed building will be supported by deep foundations comprising either driven timber piles or auger cast-in-place (ACIP) piles. Fill will be required to raise the site to design grade; however, a site grading plan specifying the required fill height was not available during the writing of this report. Therefore, we have assumed between 2 and 3 feet of fill will be placed at the site. Anticipated traffic loadings and intensities were not furnished.

Foundation Recommendations

13. All loads supporting the proposed facility should be supported on deep foundations comprising driven timber or ACIP piles. Allowable pile capacity, structural load induced settlement potential, and settlement potential due to fill placement should be considered in pile size, spacing, and length selection. All structural loads from an isolated structure (floors, walls, and columns) should be supported on piles having the same tip embedment in order to minimize differential settlement. A Visqueen® vapor barrier should be provided beneath concrete slabs to prevent capillary migration of moisture. The pile-supported slabs should be designed and constructed as rigid as possible to minimize the effects of settlement and differential settlement. In this regard, we recommend the slabs be cast monolithically with grade beams and pile caps. Flexible connections should be used for all piping and utilities going to and from the proposed facility.

14. The near-surface soils at the site are moisture sensitive. Without proper preparation and drainage, the underlying soils could produce excessive settlement and especially differential settlement of incidental grade-supported structures relative to pile-supported project features. Therefore, site preparation and drainage are extremely important. Consideration should be given to differential settlement between pile-supported structures and adjacent sidewalks, patios, parking areas/drive aisles, and other structures which are not pile-supported. The use of landscaping and hinged connections adjacent to the facility will help to mitigate the effects of differential settlement and increase the overall aesthetics of site development. However, long-term recurring maintenance of pavements and sidewalks should be anticipated especially where surface-supported features adjoin pile-supported features.

15. Final grading plans were unavailable at the time of this report. All fill required to reach finished grade beneath the proposed facility should be placed as far in advance as possible of construction operations to reduce the undesirable effects of subsoil consolidation. Consolidation settlement induced by the placement of fill can result in negative skin friction (drag loads) on the surface of piles. These drag loads have the potential to increase settlement and/or internal pile stresses within pile foundations. Therefore, Eustis Engineering should be contacted to reevaluate the recommendations presented herein once grading plans are finalized.

16. Your structural engineer should determine the appropriate foundation type for each structure based on allowable pile load capacities, pile installation considerations, and settlement estimates presented in this report. Foundation selection should also consider the settlement tolerances for each structure.

Groundwater Management

17. Construction Drainage. The initial step to prepare the site for construction should be to establish adequate drainage that will prevent ponding of water and provide immediate runoff of rainfall. We recommend the contractor maintain adequate surface drainage away from all foundation and pavement areas throughout construction. This can be accomplished by grading the site to positively drain water away from all paved areas and foundations. Sumps and pumps may be required to remove rainfall and groundwater from shallow excavations. Throughout construction, the contractor should exercise caution during those times in which the subgrade may be saturated to ensure soil support is not degraded by construction operations.

18. Permanent Drainage. The near-surface soils are subject to a reduction in shear strength and excessive settlement if allowed to become saturated (naturally or as a result of construction operations). We recommend adequate permanent drainage be provided to collect rainfall away from the proposed foundations and pavements after completion of construction. Water should not be allowed to collect near foundations or pavement areas. Particular attention should be given to any surface-founded structures and pavements, and permanent drainage should be installed to discharge rainfall away from their foundations. Surface or above grade features should be crowned or designed to direct runoff to pipes which discharge into the site's stormwater collection and disposal systems. All downspouts draining rainfall away from the building's roof should be connected to pipes which discharge into the site's stormwater collection and disposal system.

Site Preparation

19. Clearing and Stripping. Beneath the construction areas, the existing ground surface should be stripped of vegetation, loose topsoil, debris, stumps, organic matter, pavements, and any other deleterious materials. Stripping should be to a depth necessary to remove weak surficial soils and reach firm undisturbed soil. The exact depth of stripping should be determined during construction. Deeper stripping may be required if root balls are encountered. Weak zones, excavated areas, or depressions resulting from clearing, stripping, and demolition operations should be thoroughly cleaned out to the surface of firm undisturbed soil and backfilled with a select structural fill material placed and compacted under controlled conditions. Clearing and stripping should also comply with Section 201 of the Louisiana Standard Specifications for Roads and Bridges (LSSRB).

20. Demolition. All existing pavements and structures located within the proposed construction areas should be demolished and removed from the site. Provisions should be made to locate any abandoned underground utilities and foundations which could impact new construction. Existing footings or abandoned pipes should be excavated and removed from the site. These structures could impact the performance of new foundations if not properly removed, proofrolled, and backfilled with structural fill material. Existing piles, if encountered, should not be removed. In general, these features should be cut off 3 feet below grade-supported foundations or 35 feet below pavements or the existing ground surface, whichever is greater. Removal and relocation of structures and obstructions should also comply with Section 202 of the LSSRB.

21. Subgrade Preparation. After the demolition, clearing, and stripping operations, the exposed surface should be proofrolled with a bulldozer or tracked vehicle exerting a ground pressure between 10 and 15 psi. The vibratory system on the compactor, if present, should not be used during proofrolling. Alternative proofrolling techniques may be proposed, but these methods should be approved by Eustis Engineering prior to their use at the site. Any depressions, stump holes, or weak areas identified should be thoroughly cleaned out to the surface of firm undisturbed soil and backfilled with a select structural fill material placed and compacted under controlled conditions.

22. Swales. If necessary, special care should be taken to demuck any existing swales or ditches which are to be abandoned and backfilled. Muck excavation should comply with Section 203.04 of the LSSRB. These features may also require relocation to provide adequate drainage for the site. Once demucked to the surface of firm undisturbed soil, these features should be backfilled with a select fill material placed and compacted under controlled conditions.

23. Structural Fill and Backfill. A select granular material, such as locally available river sand (AASHTO A-3), should be used as form fill, backfill, and/or fill required to reach design grade. All select fill should be non-plastic and free of roots, clay lumps, and other deleterious materials and have a maximum organic content of 5% by weight. Sand fill (A-3) should have no more than 10% by weight of material passing a U.S. Standard No. 200 mesh sieve.

24. Compaction of Fill. Structural fill used as backfill or form fill beneath pile-supported structures should be spread in loose lifts of 8 to 10 inches and compacted to at least 95% of its maximum dry density near optimum moisture in accordance with ASTM D698.

Sand subbase beneath pavements should be placed and compacted as discussed subsequently in the "Pavements" section in this report. Select fill or general fill used for non-structural grading should be spread in loose lifts of 10 to 12 inches and compacted by several passes of a bulldozer.

25. Quality Control. Prior to transporting structural fill to the site, a sample of the borrow material should be tested to verify its conformance to the project specifications. Density tests should be performed on each lift of the compacted structural fill to determine if the contractor has achieved the recommended density. The frequency of these tests is dependent on the individual structure, type of fill material, and site conditions, and should be determined once these variables are known. Should you require, Eustis Engineering is available to provide additional consultation. All clearing, filling, and compaction operations should be accomplished only during periods of dry weather. The contractor should exercise caution during and after inclement weather to ensure subsoil support is not degraded by construction operations.

Fill Settlement

26. Filling and grading plans were not available during the time of our analyses. From previous correspondence, we understand approximately 2 to 3 feet of fill will be required to raise the site to construction grade. Settlement analyses were performed by modeling the fill area as a rectangularly loaded area with plan dimensions of 226' x 226' for an equivalent approximate footprint area. Structural fill was assumed to have a bulk unit weight of 120 pcf. Based on our analyses, we estimate settlement near the center of the assumed filled area for a fill height of 2 feet to be approximately 3 to 5 inches. We estimate settlement due to the placement of 3 feet of fill to be approximately 6 to 9

inches. The corners and edges of the filled area are generally anticipated to settle approximately 25% and 50%, respectively, of the maximum settlement near the center of the filled area. Should our assumption regarding fill height be incorrect, Eustis Engineering should be contacted to reevaluate settlement due to the placement of fill required to raise grade to design elevation.

Areal Subsidence

27. Areal subsidence is a result of past filling and lowering of the groundwater level over large areas. Areal subsidence is considered a background condition over which man has no control and should be relatively uniform in the project area. Insufficient information is available in this geotechnical exploration to make accurate estimates of areal subsidence in the project area.

28. The presence of near-surface organic soils should be anticipated to biodegrade and disintegrate as the groundwater is lowered. Available information indicates the disintegration of organic soils can occur at a rate of 1 to 2 inches per year for soils exposed to the atmosphere. For organic soils covered by fill or impervious clays, but subject to air exposure, the disintegration rate can be estimated as ½ to 1 inch per year.

29. Ongoing areal subsidence can result in differential settlement of grade-supported features. Additional settlement of pile-supported structures may also be observed. Biodegradation of organic deposits is not uniform due to variations in the thickness of the organic deposit and the fluctuation of groundwater level. Fluctuations of the groundwater level is typically a seasonal occurrence; therefore, the observed subsidence may be concentrated during seasonal transitions.

In-Situ Properties

30. Seismic Site Classification. The site was classified in accordance with the 2021 International Building Code® (IBC). In reference to Table 20.3-1 of ASCE 7, referenced in the IBC, this site may be categorized as Site Class E, a "soft clay soil" profile. This classification is based on the IBC criteria that there is at least 10 feet of soil in the subsurface of the site with the following three conditions: a plasticity index greater than 20, a moisture content greater than 40%, and/or an undrained shear strength of less than 500 psf.

31. Evaluation of Shrink/Swell Potential. Based on the results of available laboratory index testing, the subsoils encountered at the boring locations appear to have low potential for volumetric change; however, the potential exists for soils to exhibit expansive behavior if recommendations in this report are not utilized. Therefore, it is important that strict attention be given to site grading and recommendations regarding site drainage.

Deep Foundations

32. Allowable Pile Load Capacities. Analyses were performed to determine the estimated allowable single load capacities in compression and tension for various sizes and embedments of treated ASTM D25 quality timber and ACIP piles. The results of these analyses are provided on Figures 3 and 4. Our estimates of allowable pile capacities at the site assume a cutoff at 2 feet below the ground surface for embedment within a pile cap or grade beam and that pile installation is vertical. Our capacities are presented as depth below the existing ground surface at the time of the field exploration. Actual pile

lengths should be determined based on the finished grade elevation. Installation criteria associated with our capacity assumptions are outlined subsequently.

33. Factors of Safety. The allowable single pile load capacities presented on Figures 3 and 4 contain a factor of safety of 2.0. Use of a factor of safety of 2.0 assumes a static load test will be performed or existing, pertinent static load test data are available to verify allowable pile load capacity estimates. A one-third increase in allowable axial load capacity can be used for temporary loads as allowed by applicable codes and appropriate testing.

34. Timber Piles. We recommend the treatment of timber piles meet the current American Wood Preservers Association Standards as outlined in Section 1014 of the LSSRB for both preservative and quality assurance. Treatment should also follow Section 812.06 where applicable. Furthermore, we recommend the timber piles meet the quality (clean peeled, straightness, etc.) requirements outlined in ASTM D25 and size requirements outlined in Table X1.5 of ASTM D25 for minimum pile tips. The pile dimensions assumed in our analyses are shown on Figure 3.

35. Auger Cast-in-Place Piles. We have assumed standard installation methods will be utilized to construct ACIP piles if they are utilized for the project. Standard installation methods are defined herein as the use of a single continuous flight, hollow shaft auger to produce the pile such that the spoils are removed. Under this assumption, we have evaluated allowable pile load capacities for typical ACIP pile diameters. The nominal ACIP pile diameters assumed in our analyses are shown on Figure 4. As indicated on Figure 4, a minimum overtake volume of 20% over theoretical was assumed to estimate these capacities. Should other methods be used to install ACIP piles, like positive

displacement ACIP (those where the drilled materials remain in the hole), Figure 4 shall not be considered valid. Eustis Engineering should be contacted to perform additional analyses to evaluate allowable load capacity for ACIP piles installed by methods not discussed in this report.

36. Quality control testing should be used to confirm grout return depths, minimum adjusted volumetric overtakes, and that installation requirements are being satisfied. Recommendations for integrity testing, including minimum reinforcing, are outlined subsequently.

37. Pile Weight. The allowable load capacities presented on Figure 4 for ACIP piles do not include the weight of the pile. When computing the resultant net compressive capacity of ACIP piles, a net load of 50 pcf may be used for the weight of the concrete (weight of the concrete minus the weight of soil removed). The full buoyant weight of the concrete of 87 pcf may be used to determine the tensile capacity of the piles provided they are designed to transmit these loads. The weight of timber piles may be considered negligible.

38. Structural Capacity. The estimated pile load capacities provided are based only on a soil-pile relationship. The structural capacity of the individual piles to transmit these loads, and any connections between the piles and the structure, should be determined by a structural engineer licensed in the State of Louisiana.

39. Pile Group Capacity. Foundation piles recommended in this report will derive a majority of their supporting capacity from skin friction; therefore, it is necessary to consider the effect of group action. In this regard, the supporting value of friction piles driven in

groups should be investigated on the basis of group perimeter shear by the formula shown on Figure 5. For group effects on tensile capacities, the second term of the equation should be neglected. This formula is only applicable to vertical group effects. Lateral group effects should be evaluated by detailed soil/structure interaction analyses.

40. Pile Group Spacing. The minimum center-to-center pile spacing within a row or group of timber piles should be 3 feet. The minimum center-to-center pile spacing within a row or group of ACIP piles should be determined by the minimum spacing formula shown on Figure 5. These spacings are generally recommended for construction tolerances and do not ensure vertical or group effects will not govern the design. The minimum spacing between rows or groups of piles should also meet the requirements discussed below regarding settlement.

41. Estimated Single Pile Settlement due to Structural Loads. We estimate single piles installed to embedment depths between 30 and 60 feet below the existing ground surface will settle approximately ½ to 1 inch due to sustained structural loads. Piles having a minimum tip embedment of 60 feet below the existing ground surface are anticipated to settle approximately ½ inch or less due to sustained structural loads. Eustis Engineering should be contacted to verify these settlement estimates once structure loadings, dimensions, and pile layouts are finalized. Note, piles installed in large groups and heavily loaded can result in settlements greater than that of a single pile. These estimates do not include elastic deformation of the piles which should be added to the settlement estimates. Elastic settlement of the piles may be estimated as 75% of the static column strain of a pile acting as a column. ***These estimates of settlement are only due to structural loads and are additive to settlement due to filling.***

42. Our settlement estimates due to structural loads assume piles will be installed in small groups or widely spaced rows. We have assumed the largest group dimension will be no greater than 20% of the pile length, and the center-to-center spacing between groups will be no closer than twice the largest group dimension. We have assumed the center-to-center spacing between rows of single piles will be no closer than 8 feet or 9 pile diameters, whichever is greater. In the event any of our assumptions are not met, Eustis Engineering should be contacted to evaluate the potential settlement of the pile foundations.

43. Effects of Fill Settlement on Pile Foundations. As fill settles from consolidation of the underlying subsoils, negative skin friction (drag loads) is induced on the piles as the soil settles along the piles. These drag loads have the potential to increase settlement of friction piles. We performed analyses to estimate the downdrag settlement resulting from placement of 2 and 3 feet of fill beneath the proposed structure. We estimate the impact on pile settlement due to fill placement will be negligible for any of the structures if fill placement is limited to 1 foot or less. Our estimates for pile settlement due to placement of 2 and 3 feet of fill below the proposed structure are presented in Table 1.

TABLE 1: ESTIMATES OF FRICTION PILE SETTLEMENT DUE TO FILL PLACEMENT

PILE TIP EMBEDMENT IN FEET	ESTIMATED LONG-TERM PILE DRAG SETTLEMENT IN INCHES	
	2 FEET OF FILL	3 FEET OF FILL
30	2 to 3	4 to 5
35		
40		
45	1½ to 2	3½ to 4½
50	1 to 1½	3 to 4
55	¾ to 1	2½ to 3½
60	¾ to 1	2 to 3
65	½ to ¾	1½ to 2½
70	½ to ¾	1 to 2
80	½ or Less	½ to 1
90	½ or Less	½ to ¾

44. Downdrag settlement should be considered additive to settlement estimated for the piles due to structural loading. If more than 3 feet of fill is anticipated to be placed under the proposed structure, Eustis Engineering should be contacted to estimate the additional drag load settlement potential of the piles.

45. All piles for structurally isolated buildings or appurtenant features should be installed to the same approximate tip elevations, and concrete for the pile caps should be structurally integrated with the concrete for the grade beams and structurally supported slabs. These recommendations are made to minimize the potential for differential movements.

46. Differential Settlement Considerations. Differential settlement will occur between pile-supported structures, the ground surface, and any adjacent surface founded structures or pavements. Differential settlement may also occur between structurally integrated elements supported on different foundation types. Therefore, appropriate architectural or structural features should be incorporated into your design to

accommodate differential settlement. A joint considering vertical movements should be provided between any adjoining integrated elements founded on different foundation types to accommodate potential differential settlement.

47. Utilities. We recommend flexible type connections be specified for all piping and utilities going to and from the pile-supported structures. In addition, pipes and conduits beneath the pile-supported structures should be structurally supported by hangers attached to the structural floor slabs.

Installation of Driven Piles

48. Quality Control. All pile driving operations should be supervised by experienced personnel to ensure proper procedures are followed and accurate records are kept during all pile driving operations. The driving records should include the date, type of pile, pile tip and butt diameters, depth and diameter of predrill, overall pile length, hammer make and model, driving energy, and number of blows per foot of penetration for the full embedment of the pile. An accurate driving record is especially important to verify piles are installed to the required tip embedment and to give an indication of any unusual driving characteristics which may include pile breakage. We recommend Eustis Engineering be retained to observe, record, and evaluate all pile driving operations with respect to the recommendations presented in this report.

49. Hammers. Treated ASTM D25 quality timber piles, with minimum tip diameters of 7 inches or greater and minimum butt diameters of 12 inches, may be driven with a single-acting air hammer having a rated energy of 15,000 ft-lbs per blow. The ram weight should not exceed 5,000 pounds, and the maximum stroke should be limited to 3 feet.

50. Pile Refusal. Refusal criteria for the timber piles may be taken as 25 blows per foot with the recommended hammer to minimize damage to these piles. If the piles are driven with the aid of a follower or if the pile driving helmet is allowed to impact the ground surface, Eustis Engineering should be consulted to adjust these refusal criteria.

51. Alternate Installation Methods. We do not recommend vibratory methods be utilized for pile installation. If a vibratory hammer is selected for the project, Eustis Engineering should be contacted to evaluate the reduction in the estimated allowable pile load capacities presented on Figure 3. If any other alternate installation methods are selected, Eustis Engineering should be contacted to evaluate the impact on the estimated capacities.

52. Predrilling. Predrilling may be considered to minimize vibrations in close proximity of existing residences, to identify obstructions, or to penetrate near-surface miscellaneous fill soils or crusts. Shallow predrilling may be performed by dry auger methods to a maximum depth of 10 feet below grade. The predrill bit should be no larger than the butt diameter for shallow predrilling (less than 6 feet) of timber piles and the pile tip diameter for deeper predrilling for timber piles. Deeper predrilling may be required to penetrate the silty sand layers present within the borings and CPTs from the approximate 15 to 30 feet depths. The need for predrilling should be fully evaluated during a test pile program by those parties responsible for pile installation. Predrilling at this depth, if required, should be by wet rotary methods. In all cases, piles should be embedded a minimum of 10 feet beyond the predrill depth.

53. Pile Installation Sequence. Timber piles are considered displacement piles because soil is displaced laterally when the piles are driven into the subsurface. These piles could

cause adjacent piles to refuse at shallower depths or, more likely, could result in heaving of piles previously installed. For these reasons, we recommend pile driving take place from the center of large foundations working outward.

Installation of Auger Cast-in-Place Piles

54. Quality Control. Successful installation of ACIP piles will be a direct function of the quality control used at the site and means and methods employed by the contractor. The contractor should review the boring logs and CPT records presented in Appendices I and II to make an independent interpretation of subsoil conditions at the site and their potential impact on means and methods used to install ACIP piles. As a minimum, the quality control should include the checking of the mix, fluidity, temperature, use of additives, and taking of samples for subsequent compressive strength testing. The quality of the grout mix used for the piles should be monitored using ASTM C109 procedures. Fluidity may be checked by using the modified U.S. Army Corps of Engineers (USACE) Specifications CRD C79 and ASTM C939. Flow rates should be in the range between 10 and 25 seconds using a flow cone modified to have a 0.75-in. opening.

55. As indicated on Figure 4, an actual pile volume or "adjusted volumetric overtake," as described subsequently, of 20% over theoretical was assumed to estimate capacities. The actual pile volume will differ from the total volume of grout used to construct the pile. A more representative pile grout volume, termed "adjusted volumetric overtake," can be estimated and considers grout observed exiting the top of the augured hole during pile construction. The depth of the auger tip at which the grout is observed exiting the top of the pile is termed "grout return depth." Deeper grout return depths yield higher total grout volumes and subsequent higher volumetric overtake percentage estimates

when based on total grout volume pumped. Additionally, because of inherent irregularities in the ACIP cross-section, higher capacities may be achieved at lower volumetric overtakes. Therefore, careful attention to overtake and proper assessment of actual overtake volume are critical to quality control.

56. Quality control during pile installation should include records for each pile installed. Prior to installation of any grout, the grout pump should be calibrated in units of volume per stroke. During installation, grout pressure and volume should be recorded by flow meter and pressure meter (supplied by the pile installation contractor) in addition to recording pump strokes. The flow meter should be capable of providing the total and incremental volume of grout pumped. We recommend a maximum increment of 5 feet be implemented for the meters and manual methods. The grout return depth should also be recorded on the installation records and the adjusted grout volume estimated based on this return depth. Finally, the theoretical volume of grout should be compared to this adjusted grout volume for each pile to determine the percent over theoretical volume.

57. Eustis Engineering should be contacted if the volume of grout placed for any 5-ft segment is less than 120% of the theoretical volume for an ACIP pile. Based on our experience, grout volume overtakes greater than 20% should be anticipated for standard ACIP pile installation methods. Generally, a total volumetric overtake of at least 120% with a grout return depth of 5 to 10 feet will result in an adjusted grout overtake of at least 120%; however, this should be verified with site-specific testing. Deeper grout returns yield higher total grout volumes and subsequent volumetric overtake percentages when based on the total grout volume pumped or total volumetric overtake. If the theoretical grout volume is reached after the grout return is observed, additional testing may be

recommended. Minimum adjusted volumetric overtake requirements may be revised if review of probe/test pile installation records, integrity testing, and static load testing confirm project requirements are being met at lower adjusted grout volumes.

58. Equipment and Techniques. ACIP piles should be made by rotating a continuous flight, hollow shaft auger into the ground to the necessary depth in order to develop the desired load capacity. The auger flighting should be continuous without gaps or breaks and should have a uniform diameter throughout its length. For ACIP pile lengths exceeding 40 feet, we recommend a middle guide be used. Adjacent piles should not be installed until the pile has set for a sufficient period, as determined by the structural engineer, to withstand earthen pressures exerted by the installation of adjacent piles. Typically, a minimum 24-hour set time is recommended.

59. For placement of reinforcing steel, a minimum clear distance of 3 inches is recommended between the rebar and the outer edge of the pile. Additional cover may be needed to meet structural or code requirements. If reinforcing cages are used, they should be centered in the bore hole using centralizers or other systems. Cross-bracing, within the reinforcing cage, should not be allowed in order to minimize the potential for void development in the concrete. We also recommend a full-length center bar be installed with a centralizer in each pile for inspection purposes.

60. The grout should be designed to provide an adequate strength to support the anticipated design load. The grout head should be 5 feet higher than the fluid levels in the bore hole and/or the bottom of the auger at all times. The grout should be placed continuously from bottom to top while the auger rotates during withdrawal. Final grout return depths should be evaluated by test/probe piles.

61. We do not recommend forcing the reinforcing cage or center bars into place with the use of heavy equipment, nor do we recommend twisting the center bars into place. Should the reinforcing steel not extend to the recommended depth due to anomalies indicative of soil "cave-ins" or grout water loss in cohesionless soils, we recommend the cage or center bar be withdrawn and the piles be immediately redrilled. If difficulty in inserting the reinforcing cage or center bar persists due to grout water loss, we recommend the use of a grout intrusion aid admixture such as Intrusion-Aid® MAX, by Specrete-IP Incorporated, or an approved equivalent. Eustis Engineering should be retained during construction in order to evaluate pile installation records and provide additional recommendations if necessary.

Integrity Testing for Auger Cast-in-Place Piles

62. In order to ensure successful installation of ACIP piles, the test piles (if applicable) and a selected percentage (typically 2%) of job piles should be subjected to integrity testing using an instrumented center reinforcing bar or reinforcing cage. Once the pile design and layout have been finalized, Eustis Engineering should be contacted to determine the appropriate percentage or number of piles that should be subjected to integrity testing. For the ACIP piles presented in this report, we recommend Thermal Integrity Profile (TIP) testing or single-hole sonic logging (SSL). If these tests or installation records reveal structural defects or anomalies, additional quality control tests consisting of TIP, SSL, or low strain integrity methods including pile integrity testing (PIT) may be required. TIP testing should be performed in accordance with ASTM D7949-14 by either the probe method or thermal wire method. SSL testing should comply with ASTM D6760-16. PIT should be performed in accordance with ASTM D5882-16. Note, PIT testing typically

does not provide accurate results below 40 pile diameters and may not be fully useful in application.

63. The TIP and SSL methods require installation of an access tube (typically PVC) or wires (thermal wire method) and therefore must be coordinated prior to construction. We have assumed all ACIP piles will have a full-length center bar or reinforcing cage that can be used for the testing. These tests must also be performed within a specific time frame to maintain their accuracy. The thermal wire method requires cable(s) fitted with uniformly spaced temperature sensors be installed on the reinforcing cage (or center rebar) prior to placement into the pile. Temperature data are then collected at selected intervals during the hydration process.

64. For the access tube method for TIP and SSL testing, the access tube(s) should be free of debris and other obstructions, and the outside of the PVC tube(s) should be made coarse to aid in the bonding with the concrete grout. If SSL testing is planned, the PVC tube(s) should be filled with water immediately upon completion of installing the pile in order to minimize debonding of the concrete to the surface of the PVC tube(s). Debonding of concrete to the PVC tube(s) may show false anomalies during SSL testing. Thermal testing (probe method) requires the access tube(s) to be dry during testing.

Test Piles and Load Tests

65. Eustis Engineering considers a test pile program and load test as an extension of our geotechnical exploration. Therefore, Eustis Engineering should be retained to perform these services. If driven piles are selected for support of the proposed structure, we recommend at least six probe piles be installed within the structure's footprint to assess

installation conditions. Note, we recommend probe piles be utilized to evaluate installation conditions regardless if static load testing is planned or not.

66. The probe piles should be the same type and embedment anticipated for the job piles and installed with the same equipment and techniques proposed for the job piles. Driven probe piles will provide definitive information regarding the anticipated driving resistance, vibrations from pile driving, sound levels during pile driving, and requirements for predrilling. ACIP test piles will allow for integrity testing and providing information regarding overtake volumes (total and adjusted), grout returns, and installation techniques.

67. If the basis of design will be a factor of safety of 2 and existing, pertinent static load test data are not available, a static load test or test(s) must be performed. Eustis Engineering should evaluate existing load test data, if any, to determine relevance for the subject project. The driven probe pile with the lowest resistance to driving as indicated by penetration resistance values (blow counts) or the ACIP pile with the lowest adjusted overtake volume should be subjected to static load testing. We recommend test piles be allowed to set for at least 14 days after the installation of the reaction system. The structural and geotechnical engineers of record should select the pile to be used for performance of the static load test. The test pile should then be load tested to failure in accordance with ASTM D1143 assuming the design is governed by compressive capacity. A lateral load test or tensile load test may be required depending on the final design. Results should be evaluated by Eustis Engineering to verify the estimated pile load capacities presented in this report.

Pavements

68. Method of Analysis. The pavement components and thicknesses for rigid and flexible pavements were determined using methods presented in the AASHTO Guide for Design of Pavement Structures. Traffic data assumptions were converted to equivalent 18-kip single axle loads (E18) using AASHTO equivalency factors for flexible and rigid pavements.

69. Design Assumptions. A 20-year design life without a growth factor and a terminal serviceability index (Pt) of 2.0 were used for the analyses of flexible and rigid pavements. The resilient soil modulus (Mr) of the subgrade was estimated based on the type of soil, probable drainage conditions, and engineering experience. We have assumed the site will be prepared as recommended in this report and proper construction and permanent drainage will be provided. We have not confirmed if these design criteria meet or exceed requirements of local building codes.

70. Traffic. The amount of passenger automobiles accessing the site per day was estimated using the furnished site layout drawing presented in Appendix III. Of the amount of available parking spaces, we assumed a vehicle distribution of 50% passenger cars and 50% pickup trucks, vans, or sport utility vehicles (SUVs). Below are our assumed traffic counts used in the evaluation of the parking areas (light-duty pavement). For the drive aisles and serviceways (heavy-duty pavement), we have assumed twice this amount of light-duty vehicles. Additionally, we have assumed the heavy-duty pavement will experience two delivery trucks per day; ten multi-passenger transit vehicles per day for guest transportation; and two garbage trucks per week. We present our assumed axle weights used for our analyses in Table 2.

TABLE 2: ASSUMED VEHICLE AXLE LOADS

TYPE OF VEHICLE	AXLE LOAD IN KIPS		
	FRONT	MIDDLE	REAR
Passenger Cars	2(S)	-	2(S)
Pickup Trucks, Vans, or SUVs	2(S)	-	5(S)
Delivery Trucks and Multi-Passenger Vans	12(S)	-	20(S)
Garbage Trucks	20(S)	-	44(T)

(S) = Single; (T) = Tandem

71. Our assumed traffic intensities should be verified prior to implementation of design. If traffic conditions are different than those presented, Eustis Engineering should be contacted to reevaluate the pavement recommendations contained in this report.

72. Flexible Pavement. For the parking areas, we recommend a light-duty pavement comprising 3 inches of hot mix asphaltic surface course consisting of at least 1.5 inches of Mix Level 1 wearing course and 1.5 inches of Mix Level 1 binder course. The asphalt should be underlain by 8 inches of stone base course and 12 inches of sand subbase. For the drive aisles, we recommend 4 inches of hot mix asphaltic surface course comprising at least 1.5 inches of Mix Level 1 wearing course and 3.5 inches of Mix Level 1 binder course. The asphalt should be underlain by 8 inches of stone base course and 12 inches of sand subbase. Structural fill subbase should be placed atop the subgrade following our subgrade preparation recommendations discussed in this report.

73. Our analyses assume all flexible paving materials will conform to the LSSRB. The asphaltic surface course should conform to all requirements for Superpave (Level 1) wearing and binder courses in accordance with Section 502 of the LSSRB. The material

for the crushed stone base course should conform to the requirements of Section 1003.03.1 of the LSSRB. The stone base course should be placed and compacted in accordance with Section 302 of the LSSRB for a Class II base course. Sand subbase should follow the material specifications given in the "Structural Fill and Backfill" section of this report. Structural fill used as subbase should be compacted to at least 95% of its maximum dry density near ±2% of optimum water content in accordance with ASTM D1557. Structural fill subbase should be placed on the prepared subgrade in accordance with the site preparation recommendations given in this report.

74. Rigid Pavement. Using the same soil and traffic conditions, Eustis Engineering recommends rigid pavement for the parking areas comprises 5 inches of Portland Cement Concrete (PCC). The drive aisles should comprise 6 inches of PCC. We recommend trash container pads be at least 8 inches thick. PCC should conform to the material requirements for pavement Type B concrete, as specified in Section 901 of the LSSRB. The concrete should have a specified 28-day compressive strength of 4,000 psi to give the pavement adequate flexural strength. The concrete pavement should consider the need for reinforcement against temperature and shrinkage and should be constructed in accordance with provisions of Section 601 of the LSSRB. All joints should be sealed to prevent infiltration of water. All pavement details (i.e., wire mesh, reinforcement, dowels, joints, curbs, etc.) should be designed by a pavement design engineer.

75. The concrete should be underlain by at least 6 inches of compacted sand fill. Sand fill should conform to the material requirements given in the "Structural Fill" section of this report. The sand subbase should be compacted to at least 95% of its maximum dry density within ±2% of its optimum water content using ASTM D1557.

76. Other Considerations. The subgrade should be prepared as recommended previously under "Site Preparation and Backfill." Grades should provide for adequate drainage to prevent saturation of the subgrade, subbase, base, and surface course materials. Otherwise, adequate surface or subsurface drainage and/or edge drains should be provided. If the type and thickness of pavement components are changed, Eustis Engineering should be consulted to determine the suitability of these materials and the structural number of the pavement.

77. Material separation should be provided between the prepared subgrade and the sand subbase to improve resiliency of the pavements. This may be accomplished with a geotextile stabilization fabric. The geotextile should meet or exceed the material requirements presented in Section 1019.01 of the LSSRB. A Class C geotextile should be used beneath the sand subbase. The geotextile should be placed directly on the prepared subgrade in accordance with Section 726.03 of the LSSRB and the manufacturer's construction recommendations. All seams and ends in the geotextile should be overlapped a minimum of 3 feet, or in accordance with the manufacturer's guidelines, and secured to maintain adequate material separation.

Vibrations

78. General. Pile installation, hauling of fill materials, and other construction operations will cause vibrations that may affect nearby structures, pavements, and underground utilities. Damage due to construction vibrations is usually associated with movements of equipment, particularly heavy trucks and cranes. Vibrations associated with vehicular construction traffic are dependent on the size and speed of individual vehicles as well as frequency.

79. Measurement. If vibrations are a concern, we recommend peak particle velocities due to construction operations be monitored at critical structures or pavements with a seismograph during all construction operations that have a potential to cause vibrations. The record of peak particle velocities will provide information in assessing potential damage and the types of changes best suited to the project requirements.

80. Generally, peak particle velocities of 1.5 to 2.0 in./sec are considered to be threshold levels for structural damage. Low peak particle velocity levels can also be a problem for poorly constructed buildings or structures that have been previously stressed by settlement or other movements. In such cases, vibrations on the order of 0.5 in./sec can initiate cosmetic damage or further cosmetic damage that has already taken place in the structure. Peak particle velocities between 0.25 and 0.5 in./sec may be sensed as being detrimental by human perception. In addition, peak particle velocities of 0.25 in./sec may densify cohesionless or semi-cohesive deposits (such as fill materials and subsurface sand deposits encountered in the borings/CPTs) and result in settlement of structures founded in or above these materials. Considering the potential for cosmetic damage and the adverse perception to human response, we recommend a level of 0.5 in./sec be set as a construction tolerance for transient construction activities (events less than 1 to 2 seconds). This level is generally achievable with current construction methods. However, if sustained peak particle velocities exceed 0.25 in./sec at a pavement, utility, or structure of concern, construction activities generating these vibrations should be suspended, Eustis Engineering should be notified, and consideration should be given to altering construction procedures.

81. Mitigation Techniques. Mitigation techniques to dampen the effects of vibrations on structures are generally associated with decreasing the energy exciting vibrations through

the soil. For construction traffic, tight speed controls can greatly reduce the vibrations imparted to adjacent structures.

GEOTECHNICAL SERVICES DURING CONSTRUCTION

82. To provide continuity among the exploration, design, and construction phases, Eustis Engineering should be retained to provide additional geotechnical and materials testing services. Geotechnical engineering services may include the review of the contract plans and specifications to evaluate their conformance to the recommendations contained in this report. We can also inspect and perform compaction and in-place density determinations on fill materials; inspect and log installations of test piles and job piles; perform and evaluate static load tests; perform and evaluate integrity tests (TIP, SSL, and PIT) on ACIP piles; monitor vibrations; and test and inspect steel, asphalt, and concrete. Eustis Engineering can also perform any other soils or materials testing services, which will provide quality control during construction and conformance to design specifications.

83. In summary, Eustis Engineering should be retained to monitor all geotechnical related work performed by the contractor. If construction problems arise, Eustis Engineering should be notified to participate in the development of solutions. This participation permits the geotechnical engineer to evaluate the effects of unanticipated conditions and propose solutions on the geotechnical design assumptions particular to the project. The design geotechnical engineer may also be able to judge how site-specific soil and groundwater conditions will affect the success of a proposed construction alternative.

LIMITATIONS

84. Eustis Engineering has provided engineering services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee is expressed or implied.

85. Eustis Engineering has prepared this report in accordance with generally accepted geotechnical engineering practice for the exclusive use of TGMC for specific application to the subject site. In the event of any changes in the nature, design, or location of the proposed construction, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed, and the conclusions of this report are modified and verified in writing by Eustis Engineering. Should TGMC want to provide these data to be used by anyone other than TGMC, they shall seek written permission from Eustis Engineering, and the user must contact Eustis Engineering for interpretation of data and to secure other information which may be pertinent to the project.

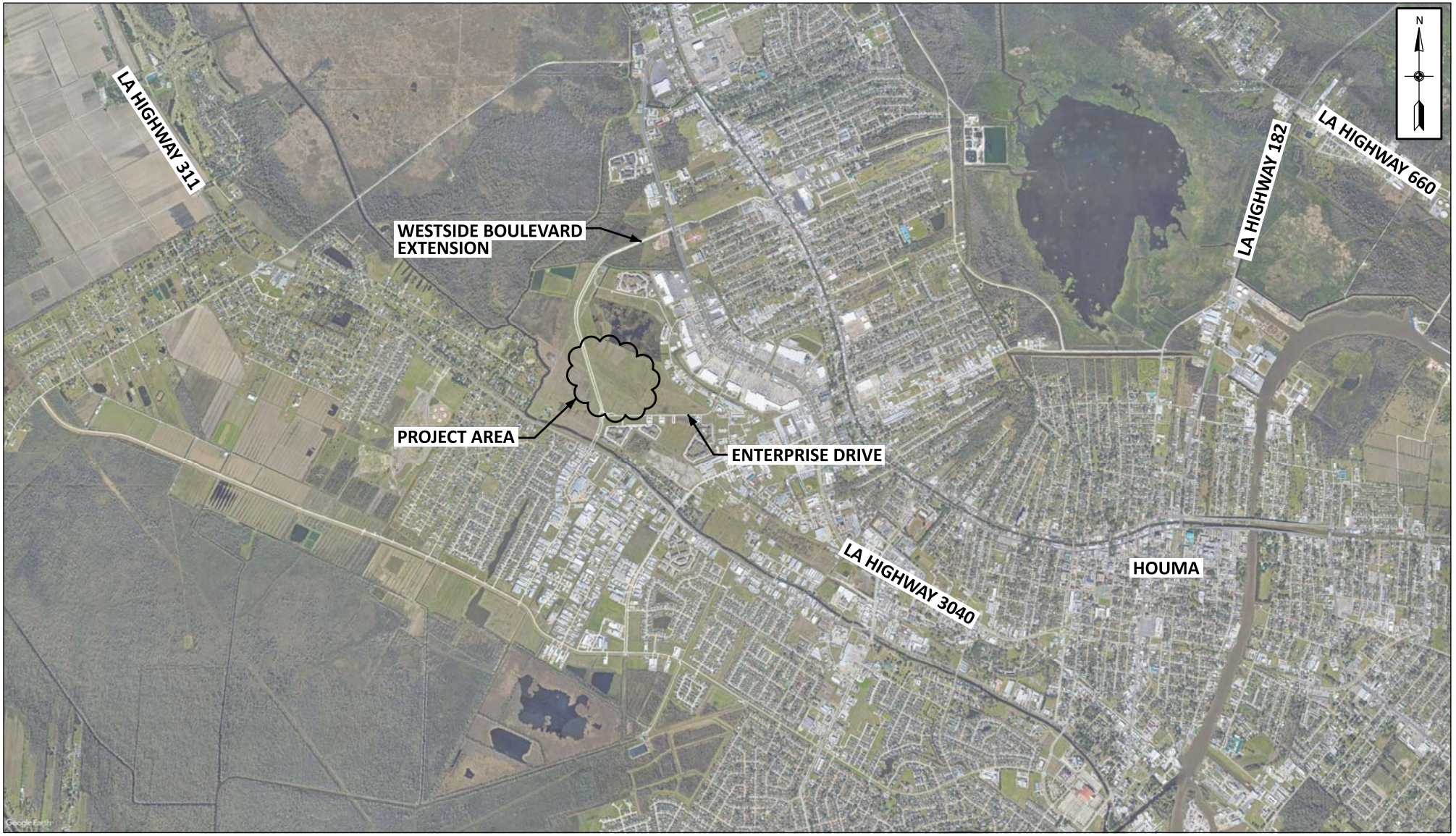
86. The analyses and recommendations contained in this report are based, in part, on data obtained from soil borings, laboratory testing, and CPTs performed for the subject project. The boring logs and CPT records are considered representative of subsurface conditions at the boring/CPT locations on the dates completed. No warranty is given that the boring logs or CPT records are representative of subsurface conditions at other locations or times. The nature and extent of variations in subsurface conditions, between and away from the boring/CPT locations, may not become evident until construction. If such variations appear, it will be necessary to reevaluate the recommendations contained in this report.

87. Recommendations and conclusions contained within this report are to some degree subjective having partial basis in engineering judgement and experience particular to the design engineer. For this reason, this report should not be included in its entirety in the contract plans and specifications without addressing the limitations of its use. However, the results of the soil borings, laboratory tests, and CPTs contained in Appendices I and II of this report may be included in the plans and specifications. The construction contractor is obliged to make an independent interpretation of subsurface conditions at the site and their potential impact on means and methods used to achieve the plans and specifications.

88. This report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the project engineer to ensure they are incorporated into the plans and specifications for the project. The owner or the owner's representative also has the responsibility to take the necessary steps to confirm the general contractor and all subcontractors follow such recommendations. It is further understood the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

89. Eustis Engineering should be provided the opportunity for a general review of the design plans and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Eustis Engineering is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of or failure to implement our recommendations.

90. The scope of our service does not include an environmental assessment or an investigation for the presence or absence of wetlands and hazardous or toxic materials in the soil; surface water; groundwater; or air on, below, or adjacent to the subject property. Furthermore, the scope of service does not include the investigation or detection of biological pollutants at the site. The term “biological pollutants” includes but is not limited to molds, fungi, spores, bacteria, viruses, and the byproducts of any such biological organisms.



SATELLITE IMAGERY DATED: 22 JANUARY 2017

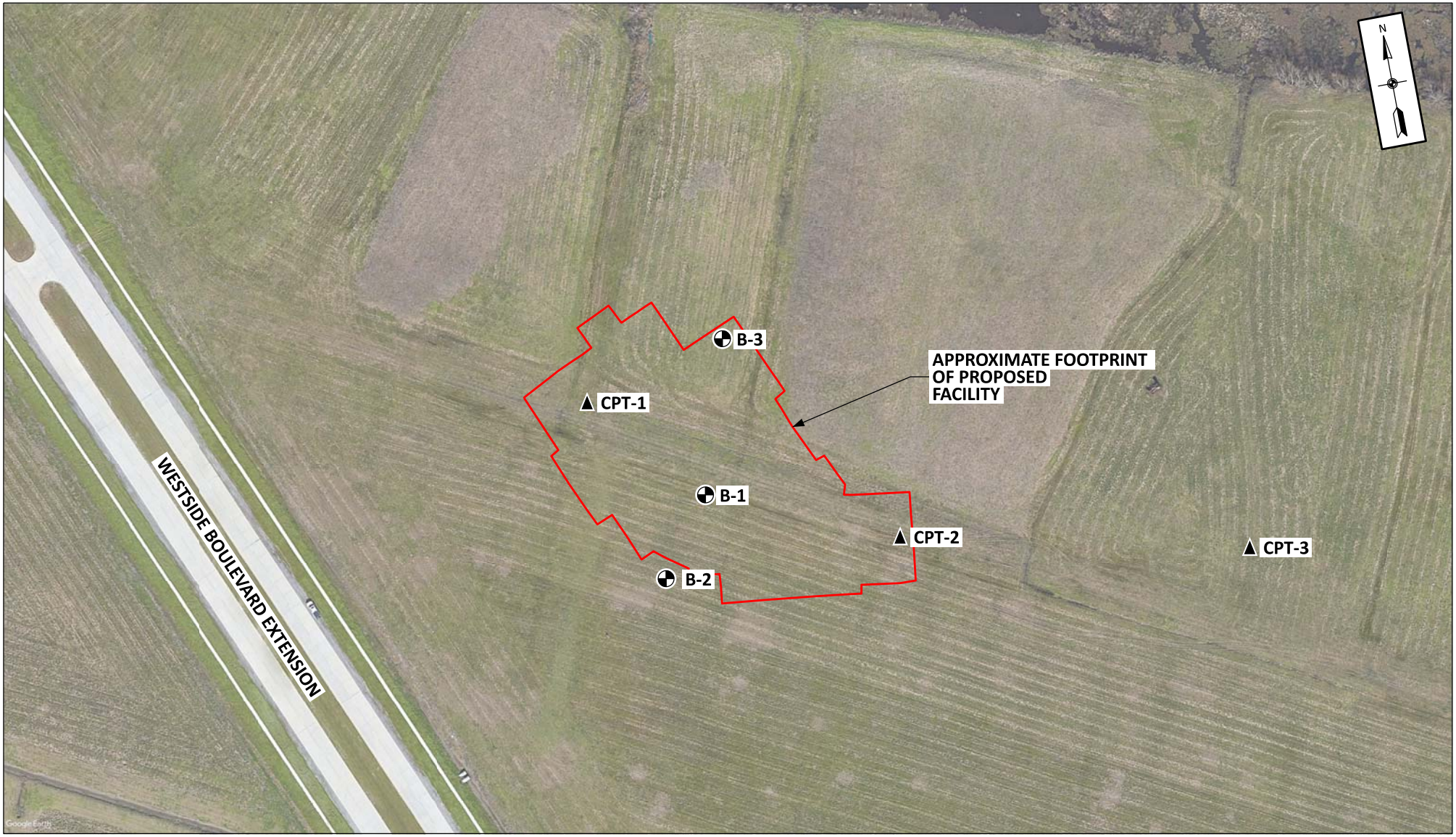
NOT TO SCALE

SITE VICINITY MAP

TERREBONNE GENERAL MEDICAL CENTER
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA
SEF PROJECT NO. 6925

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: S.T.S.	JOB NO.: 24717
CHECKED BY: S.J.B.	DATE: 23 FEB 2022
CADD FILE: VICINITY PLAN.DGN	FIGURE 1



SATELLITE IMAGERY DATED: 20 MARCH 2019

NOT TO SCALE

◓ DENOTES APPROXIMATE LOCATIONS OF SOIL BORINGS DRILLED BETWEEN 27 AND 31 JANUARY 2022

▲ DENOTES APPROXIMATE LOCATIONS OF CONE PENETRATION TESTS PERFORMED ON 31 JANUARY 2022

BORING AND CPT LOCATION PLAN

TERREBONNE GENERAL MEDICAL CENTER
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA
SEF PROJECT NO. 6925

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: S.T.S.	JOB NO.: 24717
CHECKED BY: S.J.B.	DATE: 23 FEB 2022
CADD FILE: LOCATION PLAN.DGN	FIGURE 2

TERREBONNE GENERAL MEDICAL CENTER
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA
SEF PROJECT NO. 6925
EUSTIS ENGINEERING PROJECT NO. 24717

ESTIMATES OF ALLOWABLE SINGLE PILE LOAD CAPACITIES
TREATED ASTM D25 QUALITY TIMBER PILES

PILE SIZE	PILE TIP EMBEDMENT BELOW EXISTING GROUND SURFACE IN FEET[1]	ESTIMATES OF ALLOWABLE SINGLE PILE LOAD CAPACITY IN TONS[2][3][4] FACTOR OF SAFETY ≈ 2.0[5]	
		COMPRESSION	TENSION
8-In. Tip 12-In. Butt	30 35	7½ 9	5 6
7-In. Tip 12-In. Butt	40 45 50 55	10 11½ 13½ 15	6½ 8 9 10½
7-In. Tip 13-In. Butt	60 65 70	18 20 22½	12 14 15½

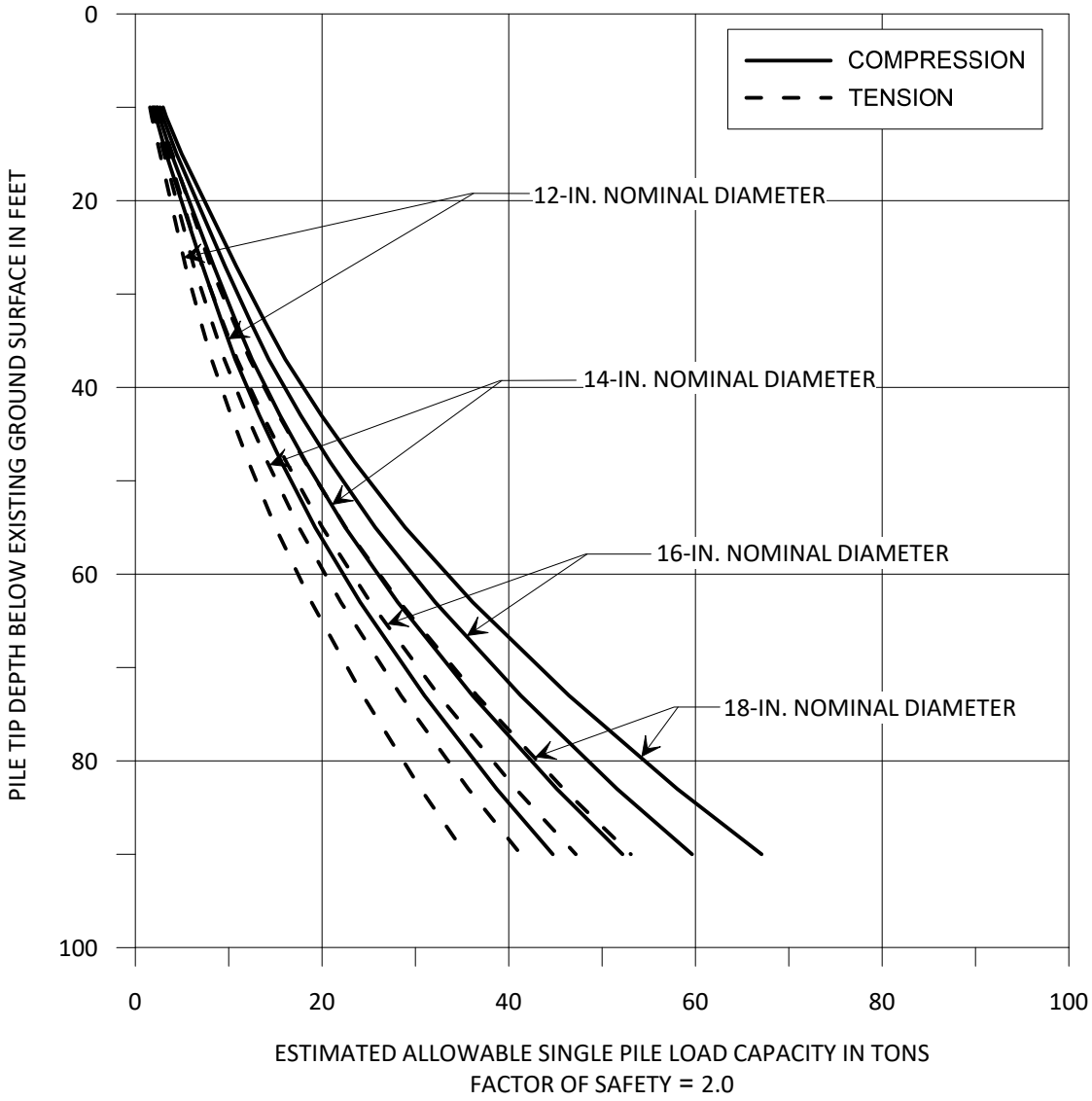
[1] Selection of pile length should consider the height of proposed fill above existing grade in order to meet minimum pile tip embedments as shown. Pile tip embedments should also consider settlement potential.

[2] Estimates include a capacity reduction for an approximate 2-ft embedment of the piles within a pile cap or grade beam.

[3] Piles assumed to be installed by impact driving equipment without assistance from vibratory equipment.

[4] These capacity estimates do not include limitations on structural capacity as imposed by some building codes.

[5] Use of a factor of safety of 2.0 assumes a static pile load test will be performed.



NOTES:

1. ALLOWABLE PILE LOAD CAPACITIES PRESENTED ON THIS FIGURE DO NOT INCLUDE THE WEIGHT OF THE PILES.
2. SELECTION OF PILE LENGTH SHOULD CONSIDER THE HEIGHT OF PROPOSED FILL ABOVE EXISTING GRADE IN ORDER TO MEET MINIMUM PILE TIP EMBEDMENTS AS SHOWN. PILE TIP EMBEDMENTS SHOULD ALSO CONSIDER SETTLEMENT POTENTIAL.
3. ESTIMATES INCLUDE CAPACITY REDUCTION FOR AN APPROXIMATE 2-FT EMBEDMENT OF THE PILES WITHIN A PILE CAP OR GRADE BEAM.
4. ESTIMATED CAPACITIES ASSUME AS-BUILT GROUTING OVERTAKES AT LEAST 120% OF THE THEORETICAL VALUE.
5. USE OF A FACTOR OF SAFETY OF 2 ASSUMES A STATIC PILE LOAD TEST WILL BE PERFORMED.
6. REFER TO REPORT FOR INSTALLATION RECOMMENDATIONS.

ESTIMATED ALLOWABLE SINGLE PILE LOAD CAPACITIES
AUGERED CAST-IN-PLACE CONCRETE PILES

TERREBONNE GENERAL MEDICAL CENTER
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA
SEF PROJECT NO. 6925

EUSTIS ENGINEERING SINCE 1946

DRAWN BY: SJB	JOB NO.: 24717
CHECKED BY: PAT	DATE: 2 FEB 2022
FILE NAME: AC APLC	FIGURE 4

CAPACITY OF PILE GROUPS

The maximum allowable load carrying capacity of a pile group is no greater than the sum of the single pile load capacities, but may be limited to a lower value if so indicated by the result of the following formula.

$$Q_a = \frac{P \; x \; L \; x \; c}{(FSF)} + \frac{2.6 \; q_u \; (1 + 0.2 \; \frac{w}{b}) \; A}{(FSB)}$$

In Which:

Q_a	=	Allowable load carrying capacity of pile group, lb
P	=	Perimeter distance of pile group, ft
L	=	Length of pile, ft
c	=	Average (weighted) cohesion or shear strength of material between surface and depth of pile tip, psf
q_u	=	Average unconfined compressive strength of material in the zone immediately below pile tips, psf (unconfined compressive strength = cohesion x 2)
w	=	Width of base of pile group, ft
b	=	Length of base of pile group, ft
A	=	Base area of pile group, sq ft
(FSF)	=	Factor of safety for the friction area = 2
(FSB)	=	Factor of safety for the base area = 3

The values of c and q_u used in this formula should be based on applicable soil data shown on the Log of Boring and Test Results for this report. In the application of this formula, the weight of the piles, pile caps and mats, considering the effect of buoyancy, should be included.

SPACING WITHIN PILE GROUPS

SPAC = $0.05 (L_1) + 0.025 (L_2) + 0.0125 (L_3)$

In Which:

SPAC	=	Center-to-center of piles, feet
L_1	=	Pile penetration up to 100 feet
L_2	=	Pile penetration from 101 to 200 feet
L_3	=	Pile penetration beyond 200 feet

NOTE: Minimum pile spacing = 3 feet or 3 pile diameters, whichever is greater

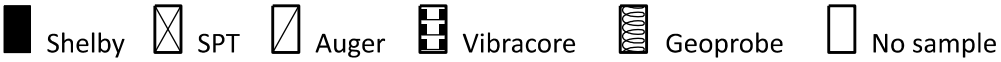
APPENDIX I

EUSTIS ENGINEERING SINCE 1946

LEGEND AND NOTES FOR LOG OF BORING AND TEST RESULTS

PP Pocket penetrometer: Resistance in tons per square foot

SPT Standard Penetration Test: Number of blows of a 140-lb hammer dropped 30 inches required to drive 2-in. O.D., 1.4-in. I.D. sampler a distance of 1 foot into the soil after first seating it 6 inches. Values shown have not been corrected.

SPLR Type of Sampling  Shelby, SPT, Auger, Vibracore, Geoprobe, No sample

SYMBOL Clay, Silt, Sand, Peat/Humus, Shells, Stone/Gravel

Predominant type shown heavy; modifying type shown light

USC Unified Soil Classification

DENSITY Unit weight in pounds per cubic foot

SHEAR TESTS

TYPE

- UC Unconfined compression shear
- OB Unconsolidated undrained triaxial compression shear on one specimen confined at the approximate overburden pressure
- UU Unconsolidated undrained triaxial compression shear
- ϕ Angle of internal friction in degrees
- c Cohesion in pounds per square foot

ATTERBERG LIMITS

- LL Liquid Limit
- PL Plastic Limit
- PI Plasticity Index

OTHER TESTS

- CON Consolidation
- -#200 Percent passing a U.S. No. 200 sieve
- SV Particle size distribution (sieve only)
- PD Particle size distribution (sieve and hydrometer)
- k Coefficient of permeability in centimeters per second
- SP Swelling pressure in pounds per square foot

Other laboratory test results reported on separate figures

GENERAL NOTES

(1) If a ground water depth is shown on the boring log, these observations were made at the time of drilling and were measured below the existing ground surface. These observations are shown on the boring logs. However, ground water levels may vary due to seasonal fluctuations and other factors. If important to construction, the depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

(2) While the individual logs of borings are considered to be representative of subsurface conditions at their respective locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-1

Project No: 24717
Date: 01/27/2022
Latitude: 29.61064°
Longitude: -90.76473°

Water Depth: See Text
Total Depth: 100.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0					Moist, soft gray & tan FAT CLAY w/trace of silt pockets & roots	CH	PB-1	0											
	0.50						2	2	43	77	110	UC	--	398	97	29	68		
5	0.50						3	5	58	66	104	UC	--	324					
	0.25				w/few silt pockets, trace of roots, & concretions		4	8	56	63	99	UC	--	366	80	25	55		
10	0.25				Moist, loose gray fine SANDY SILT w/some clay pockets	ML	5	11	32										
		14			Wet, medium dense gray fine SILTY SAND w/clay & trace of roots	SM	PB-6	13.5	35										
15		20					PB-7	16.5											
20		20					PB-8	19.5	28										
		24					PB-9	22.5	28										
25																			
	0.50				Moist, soft gray & brown ORGANIC CLAY w/few shell fragments	OH	10	28	149	31	78	OB	0	356					
30																			
	0.25				Moist, very soft gray FAT CLAY w/few silt pockets	CH	11	33	48	70	103	UC	--	218					
35																			
	0.25				Moist, soft gray LEAN CLAY	CL	12	38	41	78	110	UC	--	370					
40																			
	0.25				Moist, soft gray FAT CLAY w/trace of silt pockets	CH	13	43	50										
45																			
	0.50				w/trace of silt pockets & lenses		14	48	60	62	98	OB	0	472					
50																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-1

Project No: 24717
Date: 01/27/2022
Latitude: 29.61064°
Longitude: -90.76473°

Water Depth: See Text
Total Depth: 100.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, soft gray FAT CLAY w/trace of concretions & decayed wood	CH													
	0.50						15	53	70	57	96	OB	0	525					
55					Moist, soft gray LEAN CLAY	CL													
	0.50						16	58	37										
60					Moist, soft gray FAT CLAY w/trace of silt pockets	CH													
	0.75						17	63	46	71	104	UC	--	304					
65					Moist, medium stiff gray FAT CLAY w/trace of silt pockets & lenses	CH													
	0.50						18	68	54	68	105	OB	0	942					
70																			
	0.75						19	73	55										
75																			
	0.75						20	78	56	67	104	UC	--	561					
80																			
	0.50						21	83	58										
85																			
	0.50						22	88	51	67	102	UC	--	582					
90																			
	0.50						23	93	48										
95																			
	0.75				Moist, stiff gray FAT CLAY w/trace of silt pockets & lenses	CH	24	98	51	71	107	OB	0	1020					
100																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61036°
Longitude: -90.76502°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0					Moist, extremely soft to very soft gray & tan FAT CLAY w/few concretions & silt pockets	CH	PB-1	0	44										
	0.50						2	2	54	66	101	UC	--	118					
5	0.00				w/few silt pockets & trace of roots		3	5	62	63	102	UC	--	73	79	26	53		
	0.25				w/few decayed wood, organic matter, & roots		4	8	59	65	103	UC	--	108					
10	0.00				w/few silt lenses & pockets, wood, & trace of roots		5	11	60	64	103	UC	--	137					
					Moist to wet, loose gray fine SILTY SAND	SM	6	14	27										
15		6			w/trace of clay		PB-7	16.5	31										
		9					PB-8	19.5											
20		5					PB-9	22.5	28										
		12			Moist, medium dense gray & brown POORLY GRADED SAND w/trace of silt & organic matter	SP	PB-10	25.5											
25		18					PB-11	28.5	25										
30		WOH			Moist, very soft gray FAT CLAY w/few organic matter & roots	CH	PB-12	33.5	58						81	21	60		
35	0.75				Moist, soft to medium stiff gray FAT CLAY w/trace of silt pockets & decayed wood	CH	13	38	46	74	108	OB	0	614					
40	0.00						14	43	53	69	106	OB	0	464					
45	0.00				w/few silt lenses & layers		15	48	60	63	101	UC	--	163					
50																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61036°
Longitude: -90.76502°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, soft gray FAT CLAY w/few silt lenses & layers	CH													
	0.00						16	53	43	74	106	UC	--	469					
55					Moist, medium stiff gray FAT CLAY w/few fine sand pockets	CH													
	0.00						17	58	59	63	100	UC	--	773					
60																			
	0.50						18	63	60	64	103	OB	0	760					
65																			
	0.50				w/trace of silt pockets		19	68	58										
70																			
	0.50				w/trace of silt pockets & lenses		20	73	61	64	103	UC	--	708					
75																			
	0.50				Moist, stiff gray FAT CLAY w/trace of silt pockets	CH	21	78	64	61	100	OB	0	1128					
80																			
85																			
90																			
95																			
100																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-3

Project No: 24717
Date: 01/28/2022
Latitude: 29.61098°
Longitude: -90.76461°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Other Tests
0					Moist, medium stiff gray & brown FAT CLAY w/few decayed wood, organic matter & trace of roots	CH	PB-1	0	46						99	26	73	
	1.25						2	2	49	71	106	UC	--	575				
5	0.50						3	5	48	71	105	UC	--	623	77	25	52	
	0.50				Moist, soft gray FAT CLAY w/little decayed wood & roots	CH	4	8	66	60	100	OB	0	410				
10	0.25				Moist, extremely soft gray FAT CLAY w/little decayed wood & roots	CH	5	11	88	49	93	UC	--	49				
	0.25						6	14	89	48	90	UC	--	116				
15		17			Wet, medium dense gray fine SILTY SAND w/trace of organic matter	SM	PB-7	15.5	26									
		22					PB-8	18.5	27									
20		25					PB-9	21.5										
25		28					PB-10	24.5	28									
	0.50				Moist, medium stiff brown ORGANIC CLAY w/few decayed wood	OH	11	28	117	39	84	OB	0	747				
30	0.50				Moist, soft gray LEAN CLAY	CL	12	33	36									
35	0.50				Moist, soft gray FAT CLAY w/few silt pockets & trace of concretions	CH	13	38	50	71	107	UC	--	331				
40	0.50				Wet, soft gray LEAN CLAY	CL	14	43	37	80	110	OB	0	250	35	19	16	
45	1.50				Moist, medium stiff gray & brown ORGANIC CLAY w/some decayed wood, wood layers, & trace of clay lenses	OH	15	48	103									
50																		

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-3

Project No: 24717
Date: 01/28/2022
Latitude: 29.61098°
Longitude: -90.76461°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, medium stiff gray & brown ORGANIC CLAY w/some decayed wood, wood layers, & trace of clay lenses	OH													
	1.25						16	53	104	42	87	UC	--	631					
55																			
	0.75						17	58	104										
60																			
	0.50				Moist, soft to medium stiff gray FAT CLAY	CH	18	63	60	62	99	UC	--	308					
65																			
	0.50				w/few silt pockets		19	68	49	69	103	UC	--	504					
70																			
	0.50				w/few concretions		20	73	57	66	103	OB	0	679					
75																			
	0.50				w/trace of silt pockets		21	78	63										
80																			
85																			
90																			
95																			
100																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

APPENDIX II

EUSTIS
ENGINEERING
SINCE 1946

CONE PENETRATION
SOIL BEHAVIOR TYPE LEGEND

*OVERCONSOLIDATED OR CEMENTED

EUSTIS ENGINEERING SINCE 1946

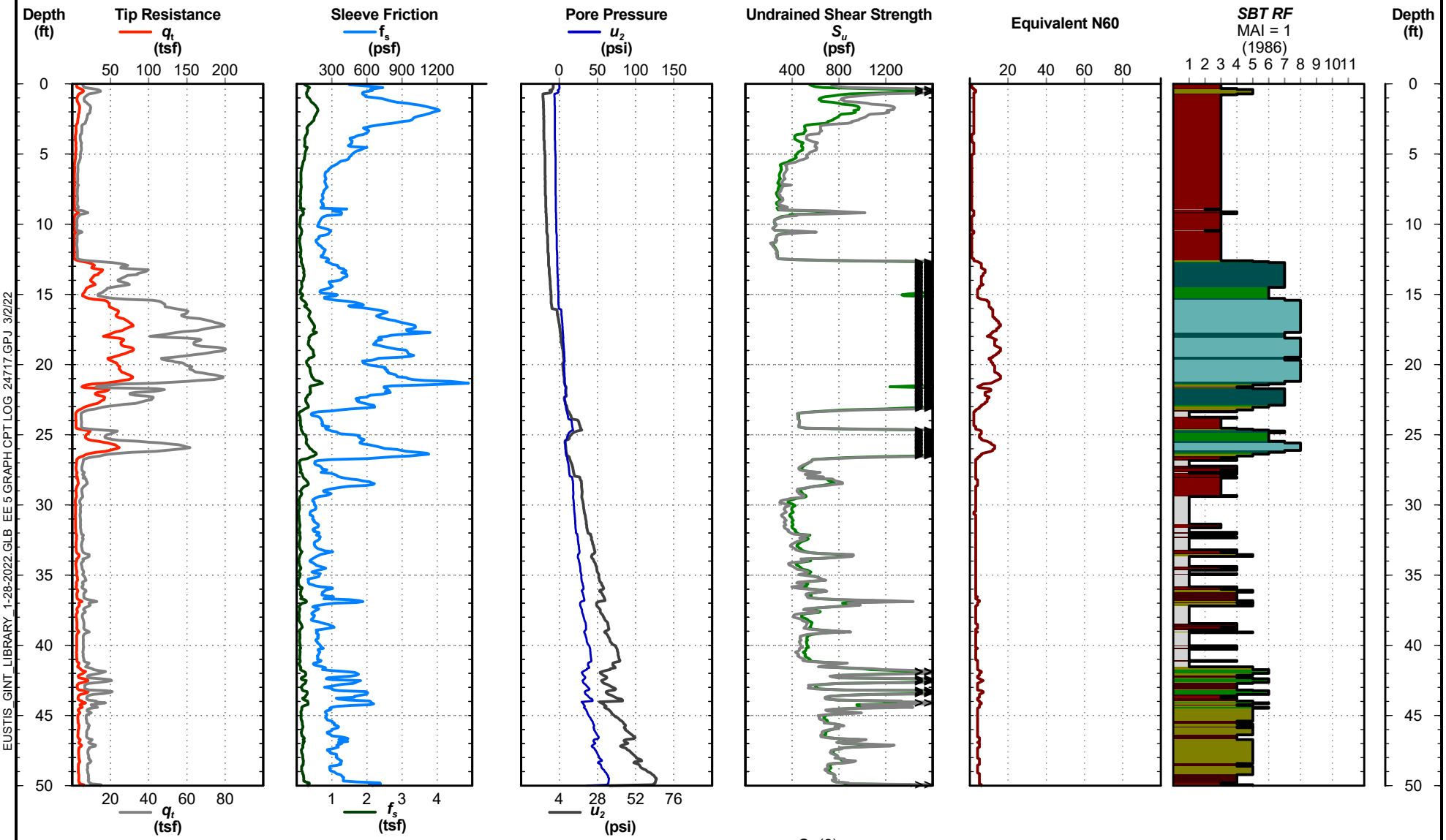
CONE PENETRATION TEST

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-1

Project No: 24717
Date: 01/31/2022
Latitude: 29.61088°
Longitude: -90.76511°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.3 ft
Operator: G. Reitmeyer



EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-1.cpt

CONE PENETRATION TEST

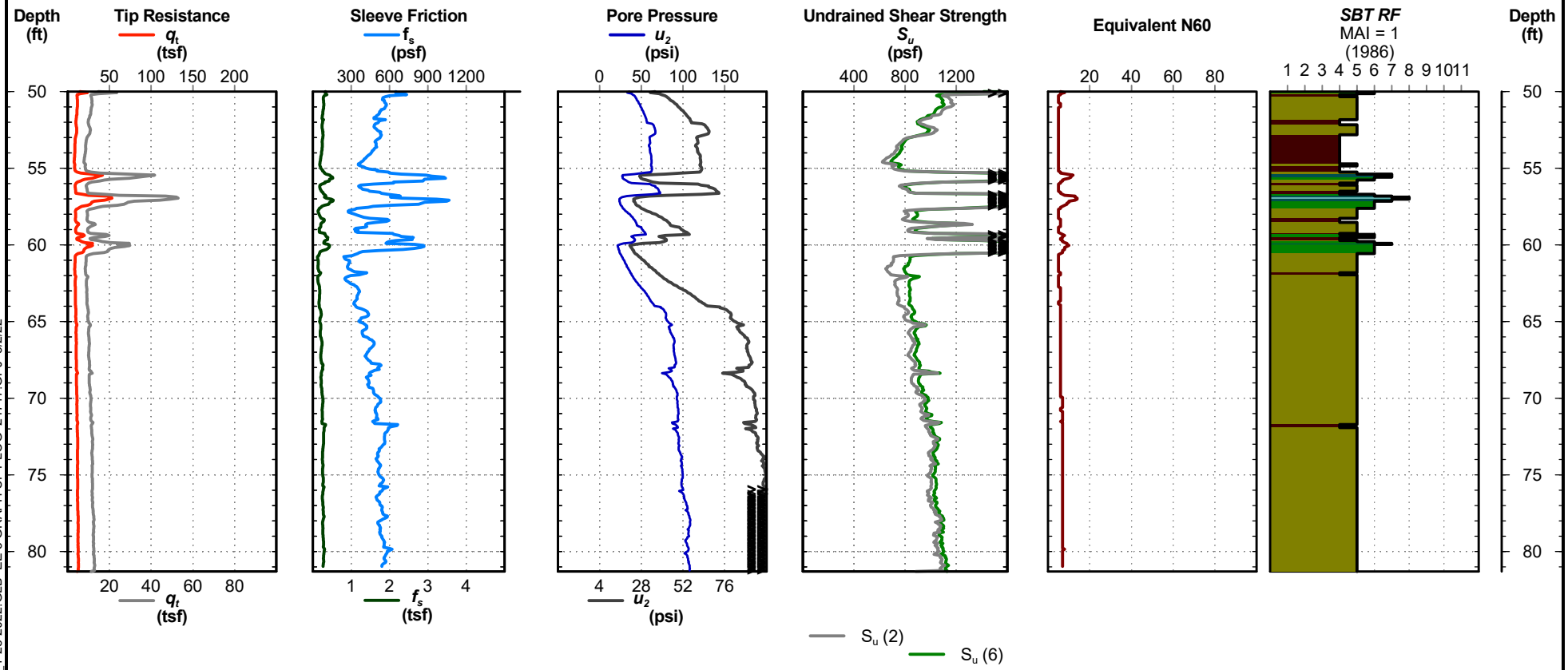
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-1

Project No: 24717
Date: 01/31/2022
Latitude: 29.61088°
Longitude: -90.76511°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.3 ft
Operator: G. Reitmeyer



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-1.cpt

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

CONE PENETRATION TEST

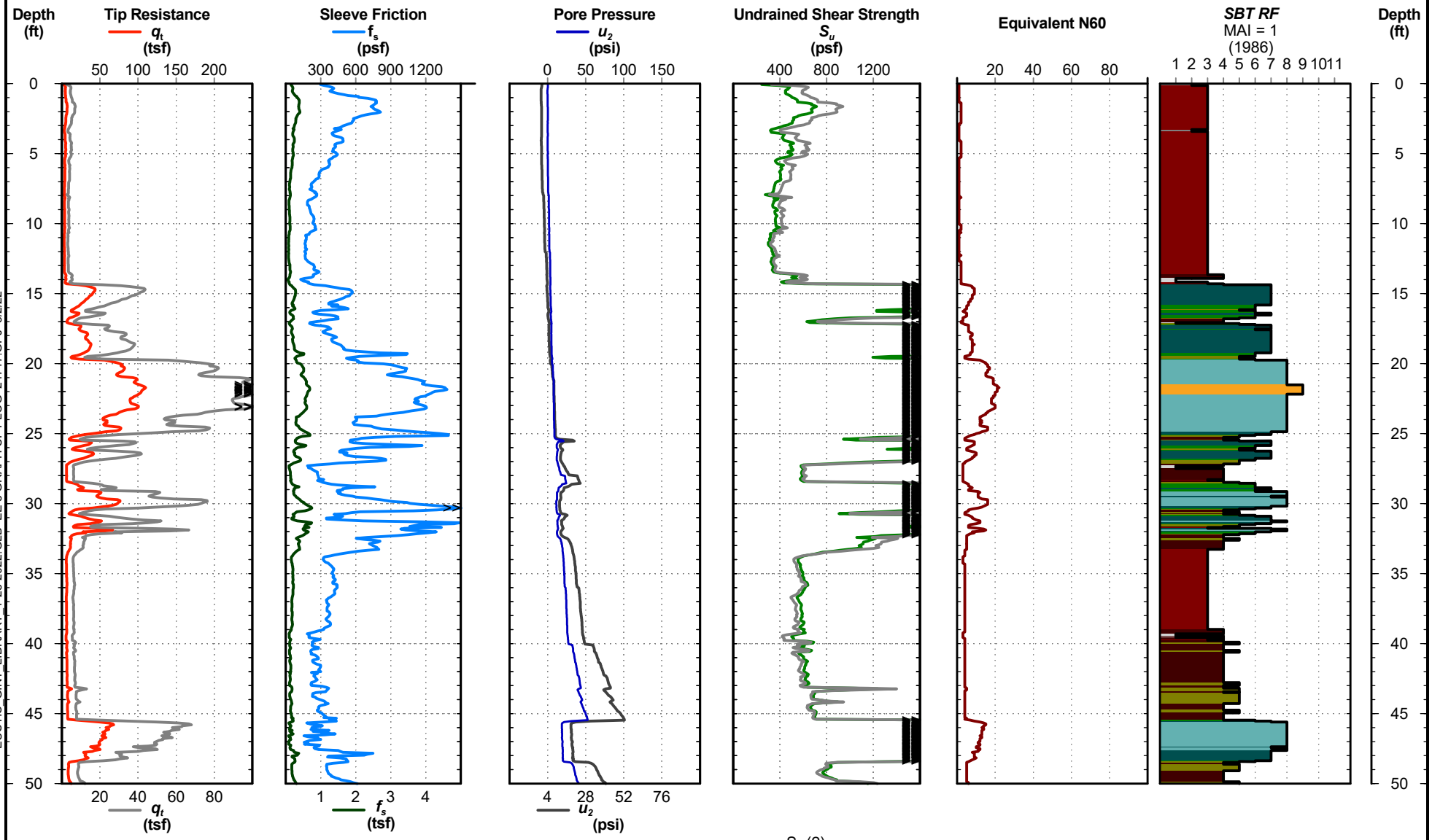
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61029°
Longitude: -90.76424°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.1 ft
Operator: G. Reitmeyer



EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

CONE PENETRATION TEST

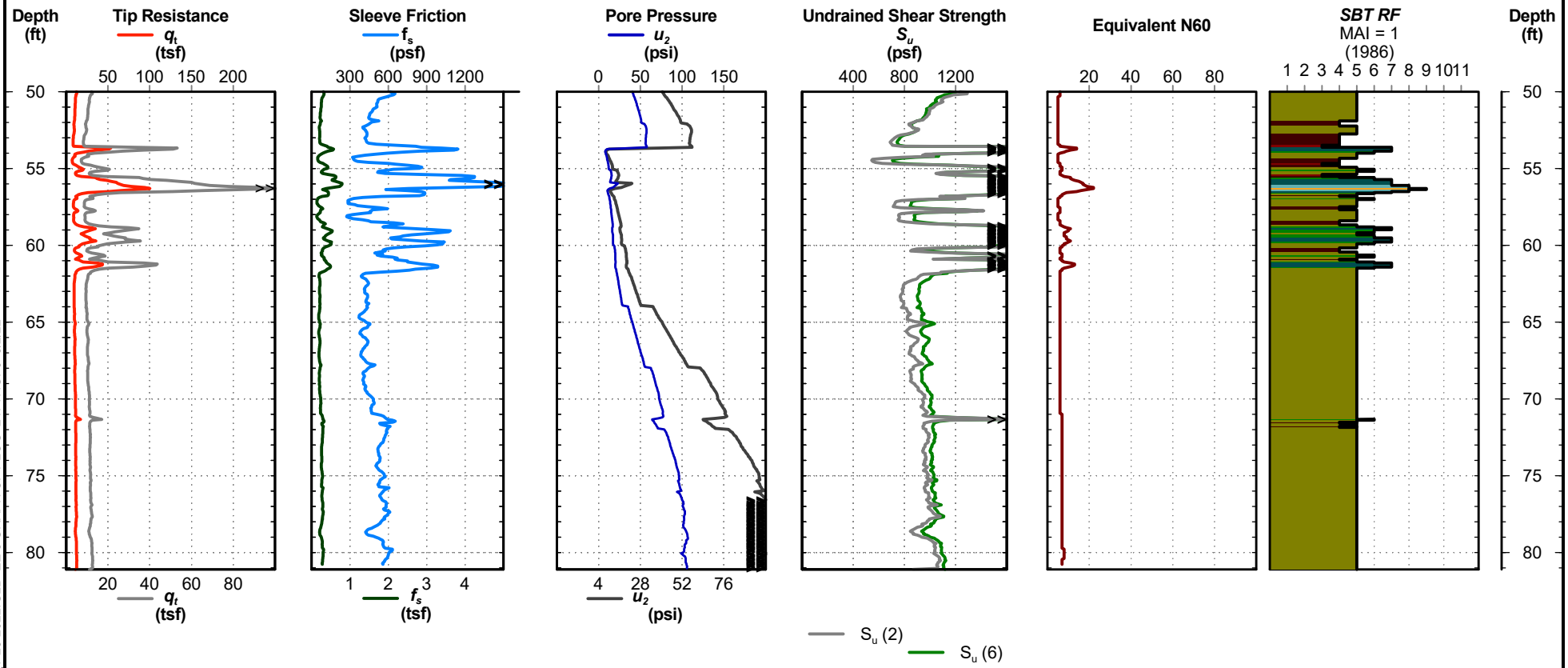
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61029°
Longitude: -90.76424°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.1 ft
Operator: G. Reitmeyer



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-2.cpt

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

CONE PENETRATION TEST

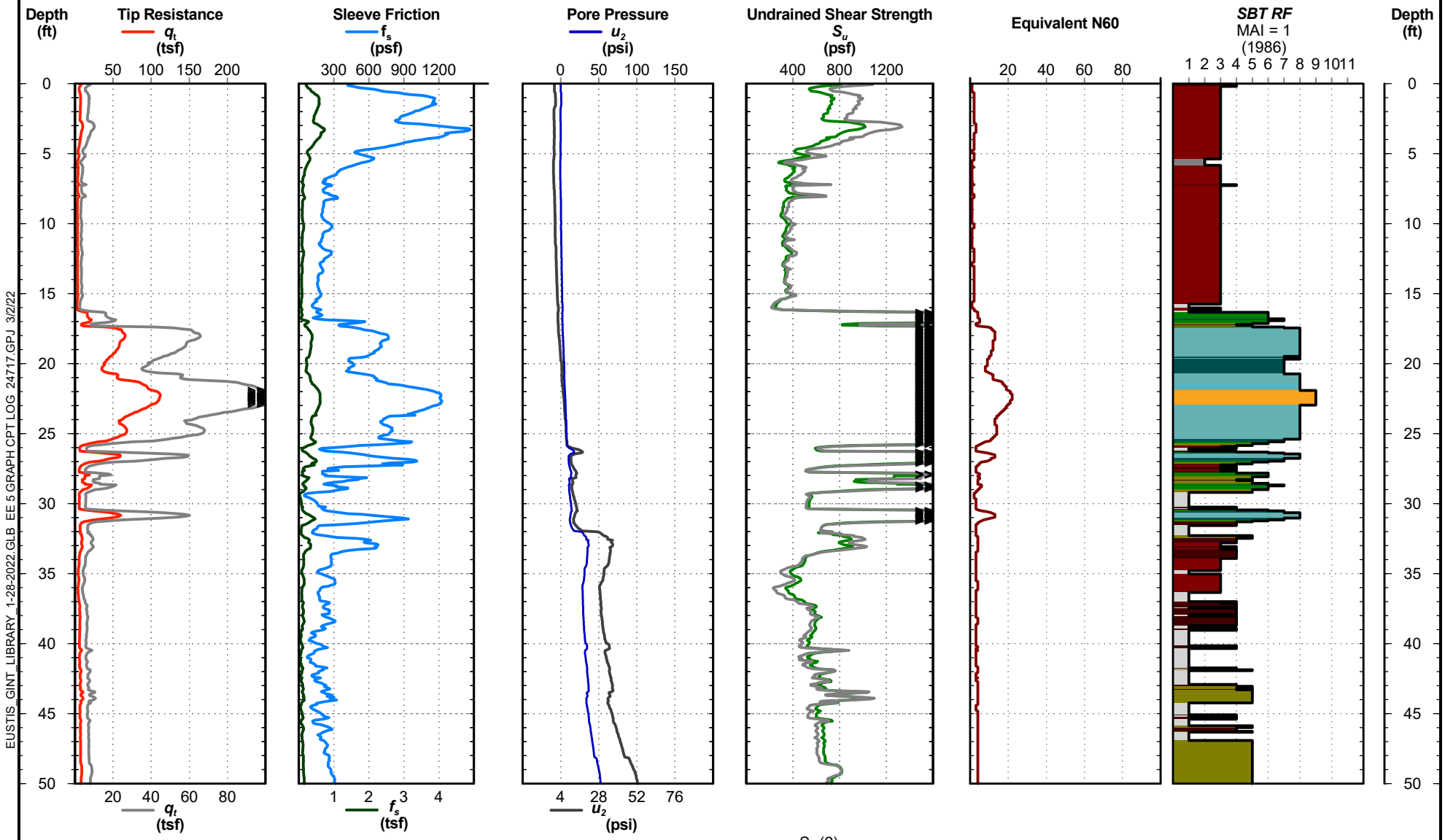
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-3

Project No: 24717
Date: 01/31/2022
Latitude: 29.60998°
Longitude: -90.76312°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.0 ft
Operator: G. Reitmeyer



EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

CONE PENETRATION TEST

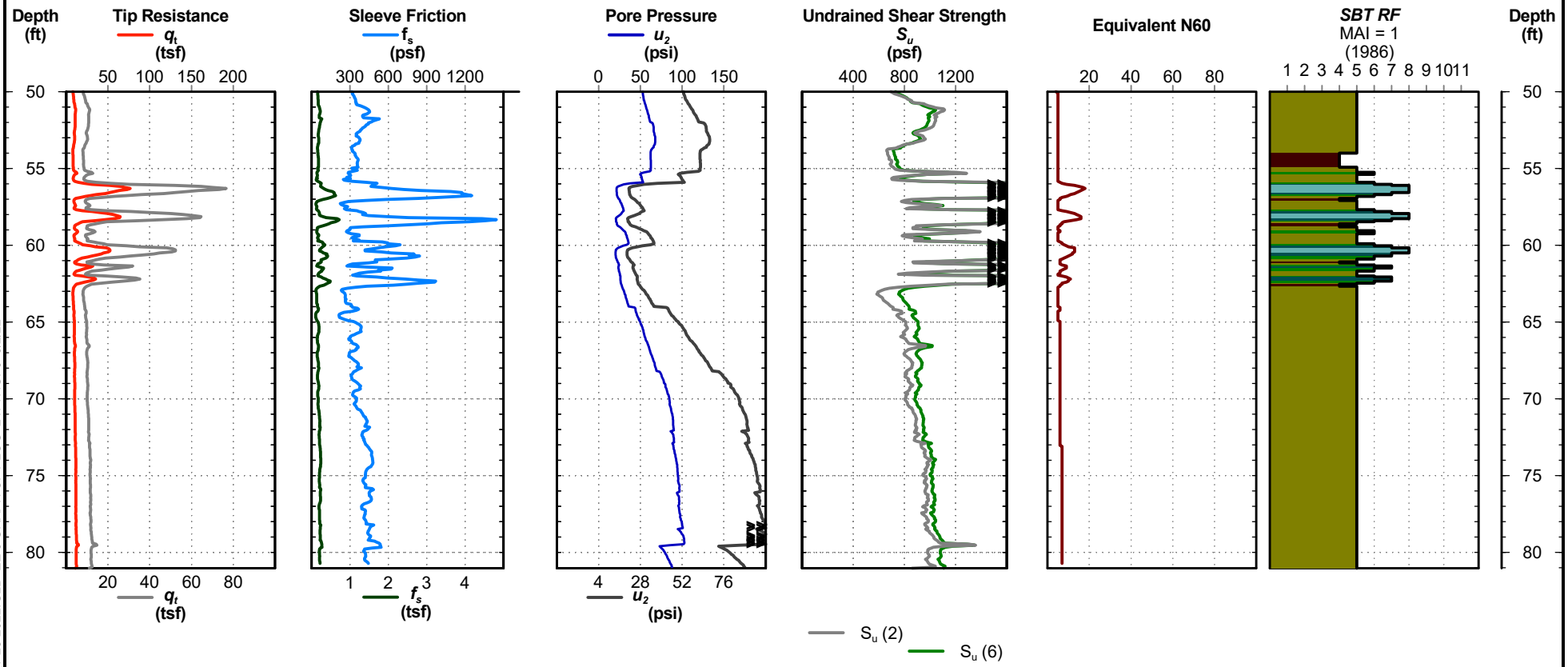
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-3

Project No: 24717
Date: 01/31/2022
Latitude: 29.60998°
Longitude: -90.76312°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.0 ft
Operator: G. Reitmeyer



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-3.cpt

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

CPT Correlations

References are in parenthesis next to the appropriate equation.

General

p_a=atmospheric pressure (for unit normalization)
q_t=corrected cone tip resistance (tsf)
f_s=friction sleeve resistance (tsf)
$R_f = 100\% \cdot (f_s/q_t)$
u_2=pore pressure behind cone tip (tsf)
u_0=hydrostatic pressure

$B_q = (u_2-u_0)/(q_t-\sigma_{vo})$
$Q_t=(q_t-\sigma_{vo})/ \sigma'_{vo}$
$F_r=100\% \cdot f_s/(q_t-\sigma_{vo})$
$I_c = ((3.47-\log Q_t)^2 + (\log F_r+1.22)^2)^{0.5}$ 2
$I_{SBT} = ((3.47-\log(q_c/p_a))^2+(\log F_r+1.22)^2)^{0.5}$ 23
$I_{c\ J\&D} = \sqrt{\{3 - \log(Q_t \cdot (1 - B_q)\}^2 + [1.5 + 1.3 \cdot \log(F_r)]^2}$ 27
$I_{c\ J\&B} = \sqrt{\{3 - \log(Q_t \cdot (1 - B_q) + 1\}^2 + [1.5 + 1.3 \cdot \log(F_r)]^2}$ 28

K_o

K_0 (1) $K_o = (1-\sin\varphi)OCR^{\sin\varphi}$
K_0 (2) $K_o = 0.1(Q_t)$ 1

Stress History

$OCR = \sigma_p'/\sigma'_{vo}$
OCR (1) $\sigma_p' = 0.33(q_t - \sigma_{vo})$ - clays 8
OCR (2) $\sigma_p' = 0.53(u_2 - u_o)$ - clays 9
OCR (3) $\sigma_p' = 0.60(q_t - u_2)$ - clays 9
OCR (4) $OCR = 0.25\ Q_t^{1.25}$ – clays 37
OCR (5) $OCR = \left[\frac{0.192*(q_t/p_a)^{0.22}}{(1-\sin(\emptyset')\cdot(\sigma'_{v0}/p_a{}^{0.31})}\right]^{\frac{1}{\sin(\emptyset'-0.27)}}$ – sands 35
OCR (6) $\sigma_p' = .101 \cdot p_a{}^{0.102} \cdot G_{max}{}^{0.478} \cdot \sigma'_{v0}{}^{0.420}$ – all soils 36

N-Value

$N_{60} = (q_t/p_a)/[8.5(1-I_c/4.6)]$ 6

Undrained Shear Strength

S_u (1) $S_u = (u_2 - u_o)/N_u$ where $7 \le N_u \le 9$ 10
S_u (2) $S_u = (q_t - \sigma_{vo})/N_{kT}$ where $15 \le N_{kT} \le 20$ 11
S_u (3) $S_u = 0.091 * ((\sigma'_{vo}{}^{0.2}) * (q_t - \sigma_{vo})^{0.8}$ 21
S_u (4) $S_u = (q_c - \sigma_{vo})/N_k$ where $15 \le N_k \le 20$ 11
S_u (5) $S_u = q_t/N_c$ where $XXX \le N_c \le YYY$
S_u (6) $S_u = q_c/N_c$ where $XXX \le N_c \le YYY$

Effective Cohesion

$c' = 0.02 * \sigma_p'$ 38

Drained Friction Angle

φ' (1)	$\varphi' = 17.6 + 11.0\text{Log}[q_t/(\sigma_{vo}')^{0.5}]$	1
φ' (2)	$\varphi' = \arctan[0.1 + 0.38\text{Log}(q_t/\sigma_{vo}')]$	13
φ' (3)	$\varphi' = 30.8\text{Log}[(f_s/\sigma_{vo}')+1.26]$ (for clays or sands)	14
φ' (4)	$\varphi' = 29.5\ B_q^{0.121}\ (0.256 + 0.33\ B_q + \text{Log}(Q_t))$	24

Unit Weight

$\rho = \gamma/\gamma_w$

$\rho = 0.8\text{Log}(V_s)$ V_s in m/sec 17

Relative Density and Void Ratio

D_R (1)	$D_R = 100(q_{c1}/305)^{1/2}$	where, $q_{c1} = q_c/(\sigma_{vo}')^{1/2}$	1
D_R (2)	$D_R = -1.292 + 0.268\ln(q_c \cdot (\sigma_{vo}'^{-0.5}))$		18
D_R (3)	$D_R = (1/2.41)\cdot\ln(q_{c1}/15.7)$		3
D_R (4)	$D_R = 1/2.91 * \ln((q_c/(61* \sigma'^{0.71}_{vo}))*100$		20
D_R (5)	$D_R = 100*(0.268*\ln((q_t/p_a)/(\sigma'_{vo}/p_a)\text{^}0.5) - 0.675)$		34

$e_o = 1.099 - 0.204\log(q_{c1})$ 1

$E_D = 5\ q_t$ $I_D = 2.0 - 0.14(R_f)$ $K_D = E_D/(34.7\cdot I_D\cdot \sigma_{vo}')$

Compressibility

$M(1) = R_m\ E_D$ where R_m= function(I_D, K_D) see the following table 22

$I_D <= 0.6$	$R_M = 0.14 + 2.36 \log K_D$
$I_D >= 3$	$R_M = 0.5 + 2 \log K_D$
$0.6 < I_D < 3$	$R_M = R_{M,D} + (2.5 - R_{M,D})\log K_D$
	$R_{M,D} = 0.14 + 0.15(I_D - 0.6)$
$K_D > 10$	$R_M = 0.32 + 2.18 \log K_D$
$R_M < 0.85$	$R_M = 0.85$

M (2)	$M = q_c\cdot 10^{(1.09-0.0075D}R^{)}$ *sands*	1
M (3)	$M = 8.25\ (q_t - \sigma_{vo})$ *clays*	1
M (4)	$M = \alpha \cdot G_{max}\ where\ 0.02 < \alpha < 2$ and $G_{max}\ is\ from\ Vs$	33

Rigidity Index

$I_R = exp\left[\left(\frac{1.5}{M} + 2.925\right)\cdot\left(\frac{q_t-\sigma_{vo}}{q_t-u_2}\right) - 2.925\right]$ where $M = 6\sin\emptyset'/(3-\sin\emptyset')$ 39

Sensitivity

S_t (1)	$S_t = 7.5/R_f$	2
S_t (2)	$S_t = (q_t - \sigma_{vo})/(15\cdot f_s)$	2

Fines Content

$FC = [(3.58-\log(q_t))^2+(1.43+\log(R_f))^2]^{1.8}$ 4

$FC = [5.31(I_{cfs})^{2.31}]+9.61$, where $I_{cfs} = [(1.95-\text{Log}Q_t)^2+(\log F_r+1.78)^2]^{0.5}$

Shear Wave Velocity

$V_s(1) = 277 \cdot q_t^{0.13} \cdot {\sigma'_{vo}}^{0.27}$ (sands) - m/s and MPa 29

$V_s(2) = 1.75 \cdot q_t^{0.627}$ (clays) - m/s and kPa 30

$V_s(3) = (10.1 \cdot \log q_t - 11.4)^{1.67} \cdot (\frac{f_s}{q_t} \cdot 100)^{0.3}$ (all soils) – m/s and kPa 31

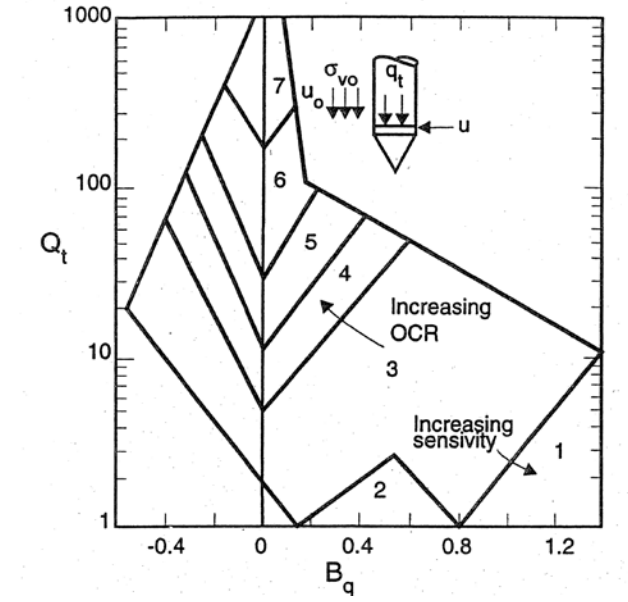
$V_s(4) = 118.8 \cdot \log f_s + 18.5$ (all soils) – m/s and kPa 32

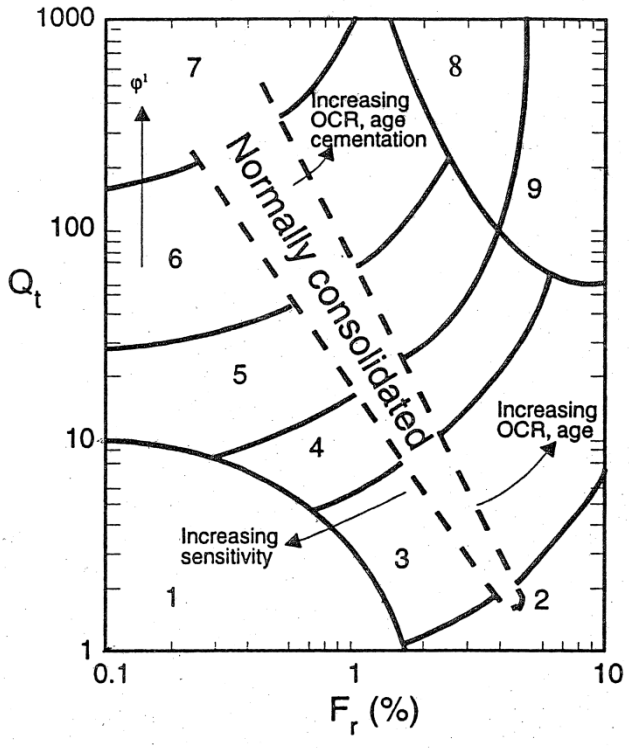
$G_{max} = \rho V_s^2$

Hydraulic Conductivity

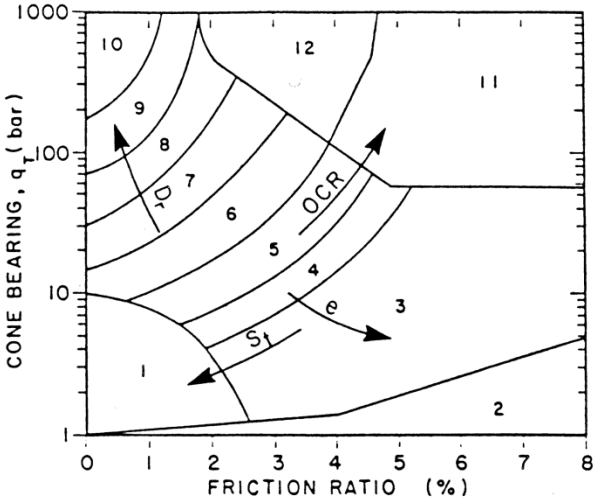
Lookup based on SBT and SBTn (1986 and 1990) 40

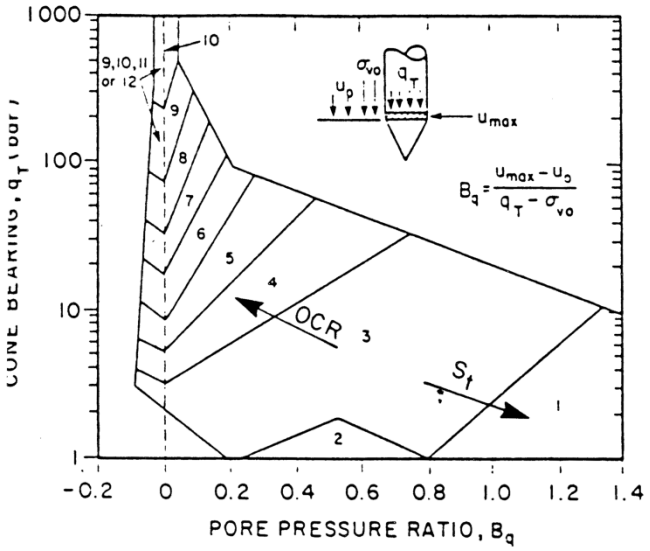
Normalized Soil Behavior Types - Robertson & Campanella (1990)





Non-Normalized Soil Behavior Types – Robertson & Campanella (1986)





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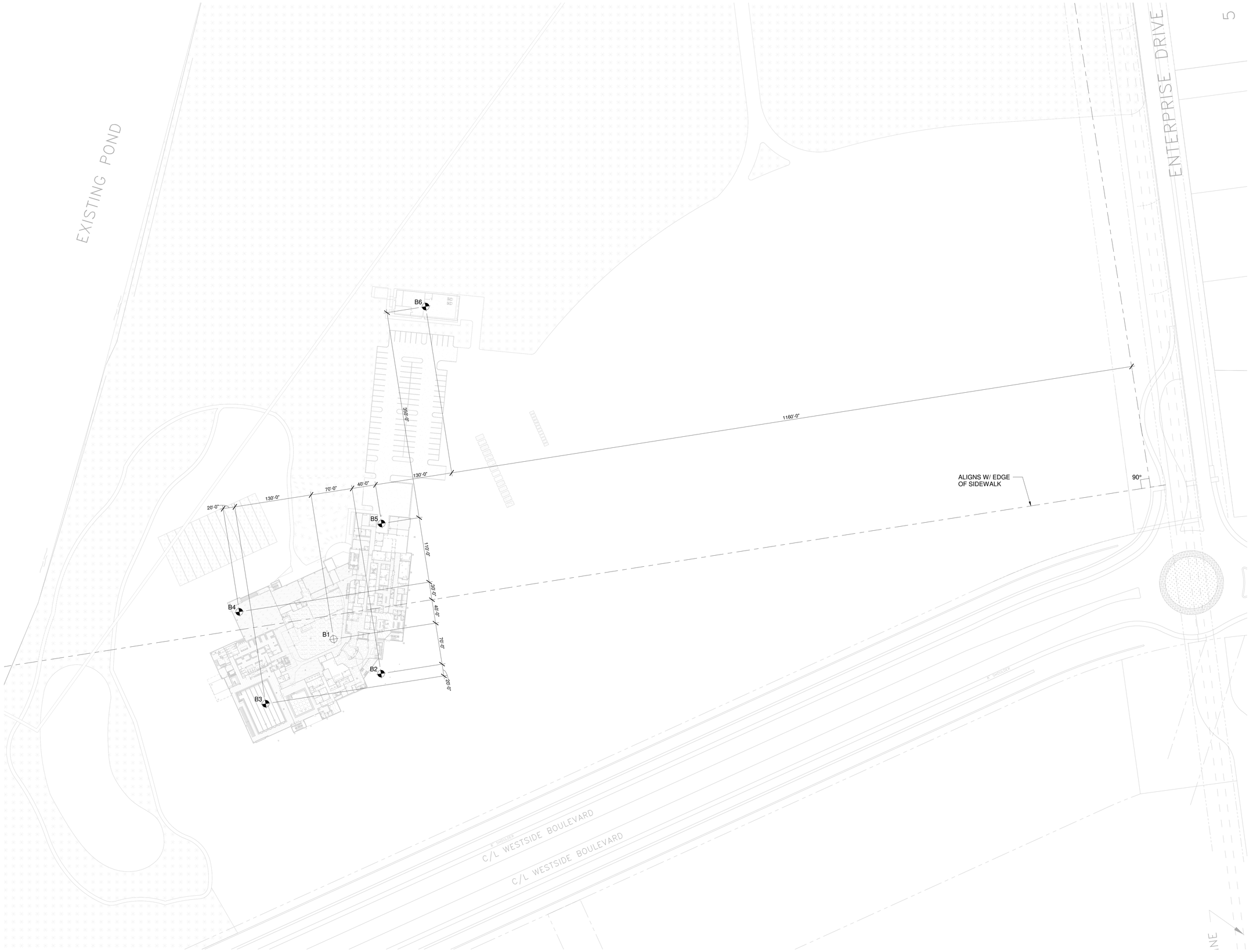
APPENDIX III



1 SOIL BORING PLAN
1" = 60'-0"

TGMC
Terrebonne General Medical Center

LEGEND

SOIL BORING PLAN LEGEND/NOTES	
MARK	DESCRIPTION
⊕	100' BORING (1 LOCATION).
◕	80' BORING (5 LOCATIONS).

VERIFY CLEARANCE FROM EXISTING UNDERGROUND UTILITIES. SEE SPECIFICATIONS.

THIS DRAWING IS THE PROPERTY OF ROZAS WARD / a.i.a. architects, AND IS NOT TO BE REPRODUCED OR COPIED IN WHOLE OR IN PART. IT IS ONLY TO BE USED FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED HEREIN.

SCALES AS STATED HEREON ARE VALID ON THE ORIGINAL DRAWING ONLY.

NO	REVISION	DATE
	SOIL BORING	01.07.22

TGMC HEALTH AND WELLNESS CENTER — PROJECT

Enter address here

Project Number — JOB NO

SOIL BORING PLAN — TITLE

As indicated — SCALE

Author /Checker — DRAWN/CHK

SB-1

ROZAS WARD architects
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1100 POYDRAS ST. SUITE 3550 NO LA 70163 504 524 4375

1/7/2022 11:40:37 AM Autodesk Docs://TGMC Health & Wellness Center/6925_TGMC HealthWellness_Struct R22.rvt

25 April 2024

AQ Studios, LLC
Suite 3550
1100 Poydras Street
New Orleans, Louisiana 70163

Attention Mr. Darren Rozas, A.I.A. and Ms. Giulia Irwin, A.I.A.
PN 1-504-524-4375
Email darren@rozas-ward.com and guilia@aqteam.com

Ladies and Gentlemen:

Additional Geotechnical Services
Terrebonne General Medical Center
Supplemental Surcharge Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925
Eustis Engineering Project No. 24717.02

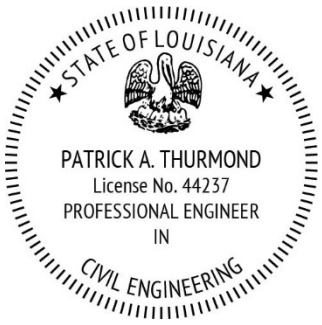
Transmitted is an electronic copy of our report covering professional geotechnical services for the subject project. An electronic copy is also being provided to Ms. Stephannie Williams, P.E., of Schrenk Endom & Flanagan LLC. A hard copy is available upon request.

Thank you for asking us to perform these geotechnical services. If you have any questions or require further clarification, please do not hesitate to contact us.

Yours very truly,

EUSTIS ENGINEERING L.L.C.

PATRICK A. THURMOND, P.E.



A.E. Stark:bal/ssp

ADDITIONAL GEOTECHNICAL SERVICES

TERREBONNE GENERAL MEDICAL CENTER

SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN

PROPOSED HEALTH AND WELLNESS CENTER

HOUMA, LOUISIANA

SEF PROJECT NO. 6925

EUSTIS ENGINEERING PROJECT NO. 24717.02

FOR
AQ STUDIOS, LLC
NEW ORLEANS, LOUISIANA

BY

EUSTIS
ENGINEERING L.L.C.
SINCE 1946

METAIRIE, LOUISIANA

25 APRIL 2024

TABLE OF CONTENTS

INTRODUCTION 1
SCOPE OF SERVICE 2
AVAILABLE GEOTECHNICAL INFORMATION 3
FIELD EXPLORATION 3
General 3
Soil Borings 4
LABORATORY TESTS 5
DESCRIPTION OF EXISTING SITE CONDITIONS 5
Site Observations 5
Stratigraphy 6
Groundwater 6
ENGINEERING ASSESSMENT AND RECOMMENDATIONS 7
Furnished Information 7
Foundation Recommendations 8
Earthen Preload/Surcharge Program 11
Deep Foundations 14
Installation of Driven Piles 19
Test Piles and Load Tests 22
Vibrations 24
GEOTECHNICAL SERVICES DURING CONSTRUCTION 25
LIMITATIONS 26

TABLE OF CONTENTS (CONTINUED)

FIGURES

Figure 1	Site Vicinity
Figure 2	Exploration Location Plan
Figure 3	Subsurface Soil Profile
Figure 4	Estimates of Single Pile Allowable Load Capacity – Square, Precast Concrete Piles
Figure 5	Estimates of Single Pile Allowable Load Capacity – Open-End Steel Pipe Piles
Figure 6	Load Capacity of Rows or Groups of Piles
Figure 7	Spacing of Pile Groups and Spacing of Piles Within Rows or Groups

APPENDICES

Appendix I	Previous Boring Logs and CPT Records
Appendix II	Current Boring Logs and Laboratory Tests

ADDITIONAL GEOTECHNICAL SERVICES

TERREBONNE GENERAL MEDICAL CENTER

SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN

PROPOSED HEALTH AND WELLNESS CENTER

HOUMA, LOUISIANA

SEF PROJECT NO. 6925

EUSTIS ENGINEERING PROJECT NO. 24717.02

INTRODUCTION

1. This report contains the results of supplemental geotechnical exploration and design performed for the proposed health and wellness facility for Terrebonne General Medical Center (TGMC) to be located in Houma, Louisiana. We provide a site vicinity map on Figure 1. The exploration was performed in general accordance with the scope of service presented in Eustis Engineering L.L.C.'s proposal, dated 24 January 2024. Ms. Giulia Irwin, Project Architect with AQ Studios, LLC (formerly Rozas Ward Architects, Inc.) provided authorization through signed acceptance of our proposal on 25 January 2024. The project owner is Terrebonne General Medical Center (TGMC). AQ Studios is the project architect. The site civil engineer and structural engineer for the project are Milford & Associates, Inc. (Milford) and Schrenk Endom & Flanagan L.L.C. (SEF), respectively.

2. Geotechnical engineering analyses and construction recommendations were provided in our previous report entitled "Geotechnical Exploration, Terrebonne General Medical Center, Proposed Health and Wellness Center, Houma, Louisiana, SEF Project No. 6925, Eustis Engineering Project No. 24717," dated 11 March 2022. We subsequently provided

a recommended preload/surcharge program in a supplemental letter entitled "Additional Engineering Analyses, Terrebonne General Medical Center, Preload/Surcharge Monitoring Program, Proposed Health and Wellness Center, Houma, Louisiana, Eustis Engineering Project No. 24717.01," dated 13 October 2023. Eustis Engineering recommended this deeper supplemental exploration in our 13 October 2023 letter to validate assumptions made for preload/surcharge analyses regarding the subsurface conditions below the terminal depth of our original exploration. Recommendations and analyses provided in our original geotechnical report, dated 11 March 2022, or supplemental letter, dated 13 October 2023, not addressed in this supplemental report remain valid.

SCOPE OF SERVICE

3. The supplemental exploration included the drilling of six undisturbed sample-type soil borings to determine subsoil conditions and stratification and to obtain samples of the various strata encountered. Soil mechanics laboratory tests, performed on samples obtained from the borings, were used to evaluate the physical properties of the subsurface soils. Engineering analyses, based on the soil borings, laboratory tests, and results of borings and cone penetration tests (CPTs) from the original exploration, were performed to provide estimates of allowable single pile load capacity for square, precast concrete (SPC) piles and validate the earthen preload/surcharge program previously recommended.

AVAILABLE GEOTECHNICAL INFORMATION

4. Geotechnical data from the original geotechnical exploration including soil borings, CPTs, and laboratory tests presented in our 11 March 2022 report were utilized for the analyses presented herein. We include soil boring logs and records of the CPT soundings from the original exploration in Appendix I. The approximate locations of borings and CPTs from the original exploration are shown on Figure 2. Subsurface profiles for borings and CPTs referenced for these analyses are shown on Figure 3.

FIELD EXPLORATION

General

5. The supplemental exploration included drilling six undisturbed sample-type soil borings at the project site. Three borings, designated as Borings B-4 through B-6, were drilled to depths of approximately 150 feet each below the existing ground surface. Three additional borings, designated as B-7, B-8, and B-9, were initially washed without sampling to the approximate 80-ft depth and then samples were collected between 80 and 150 feet each below the existing ground surface. The borings were drilled between 14 February and 16 March 2024. The boring locations were selected by SEF as shown on Figure 2. Detailed descriptive logs of the borings are presented in both tabular and graphical form in Appendix II. Approximate GPS coordinates for each boring location were obtained with a handheld device and should be considered approximate. These coordinates are shown in terms of latitude and longitude on the boring logs Appendix II. Upon completion of field operations, the borings were grouted with cement-bentonite

grout mix and backfilled with soil in accordance with current regulatory requirements by the State of Louisiana.

Soil Borings

6. The undisturbed sample-type soil borings were drilled using a track-mounted rotary-type drill rig by Challenge Testing, Inc. Samples of cohesive or semi-cohesive subsoils were obtained at close intervals or changes in stratum using a 3-in. diameter by 30-in. long thinwall Shelby tube sampling barrel (ASTM D1587). The samples were extruded from the sampling barrel in the field, inspected, and visually classified by Eustis Engineering's soil technician. Pocket penetrometer tests were performed on the soil samples to give a general indication of their shear strength or consistency. The results of these tests are shown on the boring logs under the column heading "PP." Representative samples were then promptly placed in moisture-proof containers for transportation to our laboratory.

7. Samples of cohesionless and semi-cohesive materials were obtained during the performance of in-situ Standard Penetration Tests. These tests consist of driving a 2-in. diameter sampler 1 foot into the soil after first seating it 6 inches. A 140-lb weight dropped 30 inches is used to advance the sampler. The number of blows required to drive the sampler is indicative of the relative density of cohesionless soils and the consistency of cohesive soils. The samples were retained in moisture-proof containers for preservation of their natural moisture content. The results of the Standard Penetration Tests are shown on the boring logs under the column heading "SPT."

LABORATORY TESTS

8. Soil mechanics laboratory tests, consisting of natural water content, unit weight, unconfined compression shear (UC), and unconsolidated undrained triaxial compression shear (OB), were performed on selected samples obtained from the borings. In addition, Atterberg liquid limits (LL) and plastic limits (PL) tests as well as the test establishing the percent passing a U.S. Standard No. 200 mesh sieve (-#200) were performed on selected representative samples to aid in classification and determination of the relative strength and compressibility of the subsurface soils. The results of these laboratory tests are provided on the boring logs in Appendix II.

9. To further define compressibility characteristics and stress history of the subsoils we encountered, consolidation tests (CONS) were performed on select undisturbed cohesive samples. The results of these tests performed on samples obtained from the borings are included following the boring logs in Appendix II. A total of four tests were performed.

DESCRIPTION OF EXISTING SITE CONDITIONS

Site Observations

10. The project site is located approximately 1,200 feet north of the intersection of Westside Boulevard Extension and Enterprise Drive in Houma, Louisiana. During field operations, the site consisted of predominantly cleared pastures with intermittent drainage swales. The project area is bound to the north by a pond appearing to serve as a detention/drainage area for the development area.

Stratigraphy

11. Review of the boring logs indicates near-surface deposits at the boring locations included medium stiff to very stiff brown, gray and tan fat clay that extended approximately 6 to 9 feet below the existing ground surface. These clays were underlain by very soft to soft gray, tan, and brown fat clay that extended approximately 15 to 16 feet below the existing ground surface. Next in the stratigraphy, very loose to medium dense silty sand was encountered to approximately 25.5 to 30.5 feet below the ground surface. Below this sand, soft to medium stiff gray fat clay with isolated strata of medium stiff brown and gray organic clay; loose gray sandy silt and fine sand; and loose white shells were encountered to between 50 and 60 feet below the ground surface. Medium stiff to stiff gray clay continued to approximately 135 feet below the ground surface with strata of medium stiff black and brown organic clay and wood encountered between 120 and 125 feet below the ground surface. Below the 135-ft depth, medium dense fine sand and silty sand continued to the terminal depth of the supplemental exploration approximately 150 feet below the ground surface, becoming dense to very dense near the 140-ft depth. Our interpretation of the stratigraphy at each boring location is shown on the logs in Appendix II. A subsurface profile is shown on Figure 3.

Groundwater

12. To evaluate groundwater conditions at the time of the field exploration, observations were made in an auger boring drilled near Boring B-6. The auger boring was drilled without the addition of water or drilling fluids to depths where free water was initially encountered approximately 8 feet below the existing ground surface. After an observation period of 20 minutes, free water was observed in the borehole approximately

1.7 feet below the existing ground surface. Groundwater was initially observed during our original geotechnical exploration approximately 5 to 9 feet below the ground surface subsequently rising to approximately 4 feet after observation periods ranging from 15 minutes to 24 hours. The depth to groundwater will vary with climatic conditions, local drainage improvements, water levels in the nearby pond, onsite construction activities, and other factors. For this reason, the depth to groundwater should be determined by those persons responsible for construction immediately prior to beginning work.

ENGINEERING ASSESSMENT AND RECOMMENDATIONS

Furnished Information

13. We understand that major project features will include the proposed health and wellness center building, parking lot, and an exercising field. AQ Studios and SEF previously indicated the proposed building will be supported by deep foundations comprising either driven timber piles, augered cast-in-place piles (ACIP), or SPC piles. We understand the project design currently uses driven timber piles with a pile tip embedment 70 feet below the existing ground surface supporting a single pile compressive design load of 22.5 tons.

14. Based on furnished site plans, the proposed development will include a main building with adjacent parking areas and sidewalks. We understand a finished floor elevation (FFE) for the main building is to be el 9.0 (NAVD 88). Finished grades for the proposed parking areas will vary between el 5.0 and el 4.0. Existing grades vary across the site and are generally between el 1.0 and el 5.0. At the proposed building pad, existing grades vary between el 1.0 and el 3.5. We understand portions of the site were previously filled with miscellaneous fill materials. The thickness, timing, and composition of the previous site

filling are unknown, but the fluctuation of current grades do, in fact, reflect that prior filling. To achieve a FFE for the proposed building, approximately 5.5 to 8.0 feet of fill is necessary. Between 1.0 and 3.0 feet of additional fill is necessary for grading the parking areas.

15. SEF indicated via email on 27 September 2023 that the proposed building will be supported on deep foundations with a design tolerance for a post-construction settlement of approximately ¾ inch or less. We understand handicap accessible parking areas and American With Disabilities Act (ADA) ramps will be designed for the same tolerance. SEF indicated parking areas will be designed for an anticipated post-construction settlement of approximately ¾ inch during the anticipated 20-year design life of the pavements.

Foundation Recommendations

16. Based on the results our supplemental geotechnical exploration, highly compressible organic clay and wood deposits were encountered below the proposed pile tip embedment approximately 70 feet below the existing ground surface. We estimate residual settlements after the surcharge program, as previously described in our 13 October 2023 letter, will exceed the furnished settlement tolerances; thus, requiring alterations to the prior ground improvement program which we outlined in this letter.

17. To achieve the furnished settlement tolerances, we recommend settlement-sensitive structures (defined as anything requiring less than ¾ inch of total settlement) be supported on deep foundations with tips firmly embedded in the underlying sand deposits encountered approximately 135 to 140 feet below the existing ground surface.

The depth of wicks for the proposed surcharge program should also be extended to refusal within sand deposits approximately 135 to 140 feet below existing grades. Foundation and surcharge recommendations from our 11 March 2022 geotechnical report or 13 October 2023 supplemental letter, not addressed herein, remain valid.

18. The surcharge program should be monitored using geotechnical instrumentation (during construction and during the hold period) as described in our 13 October 2023 letter to validate actual rates and magnitudes of settlement as well as to estimate the degree of consolidation at the termination of the surcharge program prior to construction moving forward. Variations in the observed magnitudes and time-rates of settlement during such ground improvement surcharge programs should be anticipated due to previous site filling activities, differences in subsurface soils encountered, and potential ongoing consolidation settlement. ***Therefore, the estimated hold period durations and resulting residual settlements may change due to additional information gained during monitoring and interpretation of the geotechnical instruments read as part of the ground improvement surcharge program.***

19. The duration and efficacy of the proposed surcharge program is affected by drainage ditches provided during the surcharge hold period as well as after construction. Adequate surface and perimeter drainage must be maintained to collect and direct water from the surcharge program, and runoff from rainfall, away from the surcharge areas. Failure to maintain positive drainage may result in slower rates of consolidation, longer required hold periods, and/or additional residual post-construction settlement. The drainage ditches also serve as a conduit to remove water that rises to the surface from the consolidation process within the foundation soils settling beneath the building surcharge pad.

20. As stated, we recommend the proposed facility be supported on a deep foundation system comprising driven piles with tip embedments firmly embedded in the underlying dense to very dense sand strata encountered approximately 135 to 140 feet below the existing ground surface. All structural loads from the proposed structure (floors, walls, and columns) should be supported on piles having the same approximate tip embedment to minimize differential settlement. Pile caps should be structurally integrated with the floor slabs and grade beams, if utilized.

21. Differential settlement should be expected between the surcharged areas with wick drains, surcharged areas without wick drains, and areas not surcharged. This may be an issue for future grade-supported features such as driveways, sidewalks, ADA ramps, and/or utilities. The potential for this differential settlement should be considered during future development. Hinged connections or joints at driveways and utilities can be used to mitigate potential differential settlements near the edge of the proposed surcharge footprint. Consideration should be given to differential settlement between pile-supported structures and adjacent sidewalks, patios, parking areas/drive aisles, and other structures which are not pile-supported. It should be noted that even with the implementation of a surcharge program, the use of landscaping and hinged connections adjacent to the facility can help to mitigate the effects of differential settlement and increase the overall aesthetics of site development. However, long-term recurring maintenance of pavements and sidewalks should be anticipated especially where surface-supported features adjoin pile-supported features.

Earthen Preload/Surcharge Program

22. Building Pad Ground Improvement Surcharge Program. For the purposes of this report we define "preload" as placing fill to the necessary design grades while the term "surcharge" is the fill placement above the necessary design grades which is placed in an effort to load the foundation soils to a stress greater than the design grades.

23. We recommend the surcharge program include wicks installed with a 5-ft triangular spacing with top of wicks at el 4 and bottom of wicks installed to refusal within underlying sand deposits encountered approximately 135 to 140 feet below the existing ground surface. Sand fill must also be placed to el 10 and be held for a minimum of 6 months (or as directed by the geotechnical engineer based on instrumentation data). At the termination of the surcharge program, the sand fill should be removed to el 2 and replaced with lightweight aggregate (LWA) fill having a total unit weight not exceeding 70 pcf to the FFE at el 9.

24. We recommend the surcharge and wicks extend, in plan view, 10 feet beyond the proposed building dimensions or other structures sensitive to settlement in plan view. To reduce the potential for differential settlement between the building pad surcharge and adjacent pavement surcharge, we recommend a 5 horizontal to 1 vertical (5H:1V) side slope to transition from el 10 to the adjacent pavement surcharge. The building pad surcharge is recommended for any structures with FFE at el 9 or requiring a total settlement tolerance less than ¾ inch. The results of our analyses for the building pad surcharge are summarized below in Table 1.

25. Pavement Areas Surcharge Program. Furnished drawings indicate approximately 1 to 3 feet of fill will be required to achieve proposed grades for the pavement areas. Based on the results of our analyses, we recommend sand fill be placed 1 foot higher than the proposed finished grades during the surcharge program across the site. This surcharge should be held for at least 6 months prior to construction of the permanent paving. Upon the termination of the surcharge program, excess material should be removed to proposed grade. We do not estimate wick drains to be required for this surcharge. These recommendations are only valid for areas receiving less than 3 feet of fill above existing grade with an allowable residual settlement of ¾ inch after 20 years. The results of our analyses are summarized below in Table 1.

TABLE 1: SUMMARY OF RECOMMENDED SURCHARGE PROGRAMS

AREA	SURCHARGE HEIGHT ABOVE PROPOSED GRADE (FEET)	SURCHARGE STACK TOP ELEVATION (NAVD 88)	ESTIMATED MINIMUM DURATION OF SURCHARGE (MONTHS)[(1)]	TRIANGULAR WICK DRAIN SPACING (FEET)	ESTIMATED CONSOLIDATION SETTLEMENT DURING SURCHARGE (INCHES)
Building Pad	Varies[(2)]	el 10	6	5[(3)]	16 to 22
Parking Area	1	Varies	6	NONE	6 to 8

[(1)] The estimated minimum duration shown is based on theoretical predictions and estimates. The total duration will be as directed by the geotechnical engineer based on the geotechnical instrumentation and observation program.

[(2)] Assumes the surcharge will comprise sand fill to be removed and replaced with lightweight aggregate from el 2 to el 9 at the end of the surcharge program.

[(3)] Wicks to be installed from 135 to 140 feet below the ground surface with top of wick tied to horizontal wicks at el 4.

26. Residual Settlement. The surcharge programs presented in Table 1 were designed to reduce post-construction residual settlement due to the placement of fill to approximately ¾ inch after 20 years for the pavement areas, and less than ¾ inch for piles supporting the proposed building.

27. Other Considerations. Our estimates of settlement include consolidation settlement of foundation materials and do not consider settlement due to improper site preparation and drainage, poor fill compaction or quality, and non-uniform foundation conditions. Durations for the surcharges are estimated based on time-rate of settlement and should be confirmed by geotechnical instrumentation. Shorter durations may be considered depending on the results of settlement monitoring; however, longer durations may also be necessary, particularly if insufficient drainage is provided.

28. Recommendations regarding both vertical and horizontal wick specifications, site preparation (including drainage, fill composition, and compaction), and instrumentation provided in our 13 October 2023 letter remain valid and must be used in conjunction with the recommendations provided in this report.

29. Areal Subsidence. The project area is affected by ongoing areal subsidence that is the result of past filling, drawdown of groundwater levels due to drainage improvements, and biodegradation of near-surface organic soils subsequent to groundwater drawdown. The amount of future subsidence cannot be reliably estimated from information developed for this report. Subsidence is generally observed to be a relatively uniform ground surface settlement over large areas. However, ongoing areal subsidence can result in differential settlement of grade-supported structures and pavements. Additional settlement of pile-founded structures may also be observed. Areal subsidence can also result in differential settlement magnitudes between grade-supported and pile-supported structures that are larger than what would be estimated by consolidation settlement theory.

Deep Foundations

30. Estimates of Single Pile Allowable Load Capacity. Analyses were performed to estimate allowable single axial pile load capacity in compression and tension for various sizes and embedments of SPC piles at the request of SEF. We also provide estimates of allowable capacity for open-end steel pipe (OSP) piles as a potentially more cost effective solution. The pipe piles were not requested but are provided for your structural engineer's consideration. The results of these analyses are provided on Figures 4 and 5, respectively. Our estimates of allowable pile capacity at the site assume a cutoff at 2 feet below the ground surface for embedment within a pile cap or grade beam and that pile installation is vertical. Our capacity estimates are presented as depth below the existing ground surface at the time of the field exploration. Actual pile lengths should be determined based on the finished grade elevation. Installation criteria associated with our capacity assumptions are outlined subsequently.

31. Factors of Safety. The allowable single pile load capacity estimates presented on Figures 4 and 5 contain a factor of safety of 2.0. Use of a factor of safety of 2.0 assumes a static load test will be performed or existing, pertinent static load test data are available to verify allowable pile load capacity estimates. As an alternative, dynamic pile testing (DPT) may be performed to confirm the load capacity estimates for driven SPC piles or OSP piles. If neither static nor dynamic load testing is performed to verify our axial pile capacity estimates, the allowable capacity estimates on Figures 4 and 5 must be adjusted for a factor of safety of 3.0. A one-third increase in allowable axial load capacity can be used for temporary loads as allowed by applicable codes and appropriate testing.

32. Precast Concrete Piles. We recommend the precast concrete piles meet the requirements outlined in Section 805.09 of the Louisiana Standard Specifications for Roads and Bridges (LSSRB), 2016 edition. Precast concrete piles should be designed to have a strand prestress structurally sufficient to facilitate handling and driving the piles without damage. Our analyses are based on a solid, square pile. Alternative precast pile configurations (pipe, triangle, etc.) should be further evaluated. Voids within square concrete piles should not significantly affect the estimates of vertical capacity. The side dimensions assumed in our analyses are provided on Figure 4.

33. Open-End Steel Pipe Piles. We recommend the OSP piles meet the requirements outlined in Sections 804 and 1013.11 of the LSSRB. The steel piles should be designed to have wall thicknesses that are structurally sufficient to withstand handling and driving stresses. The pile dimensions assumed in our analyses are based primarily on the outside pile diameter. The actual wall thickness selected for the open-end pile will generally not affect our estimates of vertical capacity. However, if a closed-end pile is considered, Eustis Engineering should evaluate the effect on the capacity and driveability. The pile dimensions assumed in our analyses are provided on Figure 5.

34. Pile Weight. As indicated above, the pile capacity estimates we present on Figures 4 and 5 do not include the weight of the pile. When computing the resultant net compressive capacity of concrete piles, a net load of 45 pcf may be used for the weight of the concrete (weight of the concrete minus the weight of soil removed). The full buoyant weight of the concrete of 87 pcf may be used to determine the tensile capacity of the pile, provided the pile is designed to transmit these loads. Similar methods may be utilized for timber or steel piles.

35. Structural Capacity. The estimates of pile load capacity provided are based only on a soil-pile relationship. The structural capacity of the individual piles to transmit these loads, and any connections between the piles and the structure, should be determined by a structural engineer licensed in the State of Louisiana.

36. Pile Group Capacity. Piles firmly embedded in the medium dense to very dense sand deposits encountered approximately 135 feet below the ground surface will derive significant compressive capacity through end bearing; thus, it will not be necessary to consider group action. Piles not tipped in the medium dense to very dense sand deposits and all piles resisting tensile loads will derive the majority of their compressive and/or tensile capacity through skin friction. Thus, the supportive compressive and tensile value of the piles driven in groups should be investigated on the basis of group perimeter shear by the formula shown on Figure 6. For group effects on tensile capacities, the second term of the equation should be neglected.

37. Pile Group Spacing. The minimum center-to-center pile spacing within a row or group of SPC piles should be determined by the minimum spacing formula shown on Figure 7. These spacings are generally recommended for construction tolerances and do not ensure vertical or group effects will not govern the design. The minimum spacing between rows or groups of piles should also meet the requirements discussed below regarding settlement.

38. Estimated Single Pile Settlement Due to Structural Loads. We estimate single piles firmly embedded within the underlying medium dense to very dense sand deposits approximately 135 to 140 feet below the ground surface will settle approximately ¼ inch or less due to sustained structural loads. Piles not firmly embedded in sand deposits

below 135 feet, but having a minimum tip embedment of 60 feet below the existing ground surface, are estimated to experience settlement of up to ½ inch due to sustained structural loads. Piles having tip embedments between 30 and 60 feet below the existing ground surface are anticipated to settle approximately ½ to 1 inch. Eustis Engineering should be contacted to verify these settlement estimates once structure loadings, dimensions, and pile layouts are finalized. Note, piles installed in large groups and heavily loaded can result in settlements greater than that of a single pile. These estimates do not include elastic deformation of the piles which should be added to the settlement estimates. Elastic settlement of the piles may be estimated as 75% of the static column strain of a pile acting as a column. ***These estimates of settlement are only due to structural loads and are additive to settlement due to fill placement, as discussed subsequently.***

39. Our settlement estimates due to structural loads assume piles will be installed in small groups or widely spaced rows. We have assumed the largest group dimension will be no greater than 20% of the pile length, and the center-to-center spacing between groups will be no closer than twice the largest group dimension. We have assumed the center-to-center spacing between rows of single piles will be no closer than 8 feet or 9 pile diameters, whichever is greater. In the event any of our assumptions are not met, Eustis Engineering should be contacted to evaluate the potential settlement of the pile foundations.

40. <u>Effects of Fill Settlement on Pile Foundations.</u> As fill settles from consolidation of the underlying subsoils, negative skin friction (drag load) is induced on the piles as the soil settles along the piles. These drag loads can potentially increase settlement of friction piles. We estimate the impact on pile settlement due to fill placement will be negligible

for any of the structures if fill placement is limited to 1 foot or less. We performed analyses to estimate the downdrag settlement resulting from placement of 5.5 and 8.0 feet of fill (as indicated by the furnished site grading plans) beneath the proposed structure. With consideration for the proposed surcharge program, we estimate piles firmly embedded within the underlying sand deposits encountered approximately 135 to 140 feet will experience ¼ to ½ inch of drag settlement. Piles not firmly embedded in the underlying sand deposits but with pile tip embedments of at least 60 feet are anticipated to experience ¼ to ¾ inch of drag settlement. Piles having tip embedments approximately 30 to 60 feet below the ground surface are anticipated to experience approximately ¾ to 1½ inches of drag settlement due to the placement of the proposed building pad. These drag settlement estimates assume piles are installed after the proposed surcharge program.

41. Piles firmly embedded within the underlying sand deposits should also be evaluated for their structural adequacy for potential drag load. Estimates of additional loads on piles firmly embedded in sand deposits encountered approximately 135 to 140 feet below the ground surface are presented in Table 2. ***These loads should be added to the applied load at the pile butt and the total load should be used to evaluate internal stresses and the structural adequacy of the piles. However, the allowable capacity estimates shown on Figures 4 and 5 should not be reduced for these loads unless the structural adequacy of the piles is exceeded.***

TABLE 2: ESTIMATED COMPRESSIVE LOADS ON PILES FIRMLY EMBEDDED IN SAND DEPOSITS DUE TO FILL PLACEMENT

PILE TYPE	PILE SIZE (INCHES)	ESTIMATED ADDITIONAL COMPRESSIVE LOAD DUE TO PROPOSED FILL PLACEMENT (TONS)
Square, Precast Concrete	14	84
	18	108
	24	144
Open-End Steel Pipe	14	66
	18	85
	24	113

42. Downdrag settlement should be considered additive to settlement estimated for the piles due to structural loading. Drag loads are not anticipated for piles not firmly embedded in the underlying sand deposits. If more than 8 feet of fill is anticipated to be placed under the proposed structure, Eustis Engineering should be contacted to estimate the additional drag load settlement potential of the piles.

43. Utilities. We recommend flexible-type connections be specified for all piping and utilities going to and from the pile-supported structures. In addition, pipes and conduits beneath the pile-supported structures should be structurally supported by hangers attached to the structural floor slabs.

Installation of Driven Piles

44. Quality Control. All pile driving operations should be supervised by experienced personnel to ensure proper procedures are followed and accurate records are kept during all pile driving operations. The driving records should include the date, type of pile, pile

tip and butt diameters, depth and diameter of predrill, overall pile length, hammer make and model, driving energy, and number of blows per foot of penetration for the full embedment of the pile. An accurate driving record is especially important to verify piles are installed to the required tip embedment and to give an indication of any unusual driving characteristics which may include pile breakage. We recommend Eustis Engineering be retained to observe, record, and evaluate all pile driving operations with respect to the recommendations presented in this report.

45. Hammers. Generally, we recommend a single-acting air hammer be used to install concrete or steel piles. The manufacturer's rated energy required to drive the piles will depend on the piles' allowable compressive capacity. The estimated hammer energy versus allowable compressive capacity (factor of safety ≈ 2.0) for piles recommended in this report is provided in Table 3. For precast concrete piles, we also recommend the ram stroke be limited to 3 feet, and the ram weight be approximately one-half of the pile weight.

TABLE 3: RECOMMENDED SINGLE-ACTING AIR HAMMER DRIVING ENERGIES

ESTIMATES OF ALLOWABLE SINGLE PILE LOAD COMPRESSIVE CAPACITY ASSUMING FACTOR OF SAFETY ≈ 2.0 (TONS)	APPROXIMATE RATED SINGLE-ACTING HAMMER ENERGY (FT-LBS/BLOW)
Up to 60	19,500
60 to 120	24,000
120 to 180	32,500

46. For piles with allowable compressive capacity estimates in excess of 180 tons, we recommend pile driving equipment be selected using Wave Equation methods as described in Section 804 of the LSSRB. Selection of the driving equipment should also consider requirements for the testing program.

47. Alternative Hammers. A diesel or hydraulic hammer may also be used for the installation of concrete or steel piles. We recommend a diesel hammer have a rated energy of one and one-half times the energy recommended for a comparable installation with a single-acting air hammer. Similarly, a hydraulic hammer should have a rated energy that is equated to the air hammer based on efficiency. Other impact hammer types may also be suitable for pile impact installation. We recommend dynamic analyses be performed for hammer selection and approval if hammer type is not an air hammer. In addition, DPT should be conducted if a diesel hammer or other variable energy hydraulic hammer is proposed for installing concrete piles. This testing will reduce the risk of overstressing the piles which can occur during soft driving (i.e., excessive tensile stresses can develop when concrete piles advance rapidly through soft soils, particularly when driven by a diesel hammer).

48. Alternative Installation Methods. We do not recommend vibratory methods be utilized for pile installation. If a vibratory hammer is selected for the project, Eustis Engineering should be contacted to evaluate the reduction in the estimates of allowable pile load capacity presented on Figures 4 and 5. If any other alternative installation methods are selected, Eustis Engineering should be contacted to evaluate the impact on the capacity estimates.

49. Predrilling. Predrilling may be considered to minimize vibrations in close proximity of existing residences, to identify obstructions, or to penetrate near-surface miscellaneous fill soils or crusts. Shallow predrilling may be performed by dry auger methods to a maximum depth of 10 feet below grade. The predrill bit should be no larger than the pile width for shallow or deeper predrilling for concrete piles. Deeper predrilling may be required to penetrate the silty sand layers present within the borings and CPTs from the

approximate 15 to 30-ft depths. The need for predrilling should be fully evaluated during a test pile program by those parties responsible for pile installation. Predrilling at this depth, if required, should be by wet rotary methods. In all cases, piles should be embedded a minimum of 10 feet beyond the predrill depth.

50. Pile Installation Sequence. SPC and OSP piles are considered displacement piles because soil is displaced laterally when the piles are driven into the subsurface. These piles could cause adjacent piles to refuse at shallower depths or, more likely, could result in heaving of piles previously installed. For these reasons, we recommend pile driving take place from the center of large foundations working outward.

51. Dynamic Analyses. The SPC piles and OSP piles should be designed by a structural engineer to have a cross-section which is structurally sufficient to facilitate driving of the piles without damage. Wave Equation Analysis of Piles (WEAP), or dynamic analyses, can be performed to evaluate driving stresses, pile cushion, and driveability once the hammer and appurtenant equipment have been selected. Structural requirements can then be verified by a structural engineer and installation criteria can be established. Eustis Engineering recommends hammer approval by WEAP analyses in accordance with Section 804.05.02 of the LSSRB.

Test Piles and Load Tests

52. Eustis Engineering considers a test pile program and load test as an extension of our geotechnical exploration. Therefore, Eustis Engineering should be retained to perform these services. If driven piles are selected for support of the proposed structure, we recommend at least six probe piles be installed within the structure's footprint to assess

installation conditions. Note, we recommend probe piles be utilized to evaluate installation conditions regardless of whether static load testing is planned or not.

53. The probe piles should be the same type and embedment anticipated for the job piles and installed with the same equipment and techniques proposed for the job piles. Driven probe piles will provide definitive information regarding the anticipated driving resistance, vibrations from pile driving, sound levels during pile driving, and requirements for predrilling.

54. If the basis of design will be a factor of safety of 2.0 and existing, pertinent static load test data are not available, a static load test or test(s) must be performed. Eustis Engineering should evaluate existing load test data, if any, to determine relevance for the subject project. The driven probe pile with the lowest resistance to driving as indicated by penetration resistance values (blow counts) should be subjected to static load testing. We recommend test piles firmly embedded in sand deposits encountered approximately 135 feet below the ground surface be allowed to set for at least 7 days after the installation of the reaction system. Test piles at other tip embedments should be allowed to set for at least 14 days after the installation of the reaction system. The structural and geotechnical engineers of record should select the pile to be used for performance of the static load test. The test pile should then be load tested to failure in accordance with ASTM D1143, assuming the design is governed by compressive capacity. A lateral load test or tensile load test may be required depending on the final design. Results should be evaluated by Eustis Engineering to verify the estimates of pile load capacity presented in this report.

55. Dynamic Pile Tests. The initial installation of driven SPC or OSP test/probe piles and job piles may be monitored and evaluated using DPT with a Pile Driving Analyzer® (PDA). The performance of DPT may be used to evaluate actual driving stresses, penetration of resistance, and integrity and capacity of the test piles and/or job piles. The PDA can also monitor energy transferred to the pile from the hammer and evaluate installation efficiency. In order to evaluate pile capacity, "restrike" DPT should be performed at least 14 days after its initial installation. Shorter set times may be considered but the ultimate capacity of the pile may not be realized. In addition, an increased hammer energy may be required for the restrike DPT to fully mobilize the pile. Data from this restrike should be further evaluated by signal matching verification of the computed capacity at the time of testing by CAPWAP® analyses. Eustis Engineering is available to perform and evaluate the results of DPT and CAPWAP analyses. If a PDA is used as the sole means to evaluate capacity to establish allowable capacity estimates, the factor of safety should be increased from 2.0 to 2.5.

Vibrations

56. Pile driving, as well as other construction activities, has the potential to generate vibrations that may affect nearby structures, pavements, and underground utilities. Eustis Engineering recommends vibrations be monitored during the test pile program and subsequent construction activities of concern. In addition, vibration monitoring may be a requirement for certain features within 1,500 feet of the Mississippi River levee (MRL). Construction permits should be reviewed to determine if vibrations need to be monitored at the MRL. This monitoring should evaluate peak particle velocities during pile driving at critical structures with a seismograph, as well as other construction activities generating vibrations (hauling of fill, moving heavy equipment, etc.). The record of peak particle

velocities will provide information in assessing potential damage and the need for changes in construction operations.

57. Peak particle velocities (measured at a structure, pavement, or utility of concern) exceeding 0.50 in./sec may induce damage to the feature, particularly when this feature has been previously stressed by settlement or other movements. Peak particle velocities between 0.25 and 0.50 in./sec may be sensed as being detrimental by human perception. Peak particle velocities of 0.25 in./sec have been documented to cause densification of cohesionless materials, which may be present as fill near the site. Densification of these materials could result in settlement and subsequent damage to pavements, structures, or utilities founded in or above these materials. If sustained vibration levels of 0.25 in./sec are measured at a structure, pavement, or utility of concern, Eustis Engineering should be notified, the construction operations generating these vibrations terminated, and consideration given to altering these procedures.

GEOTECHNICAL SERVICES DURING CONSTRUCTION

58. To provide continuity among the exploration, design, and construction phases, Eustis Engineering should be retained to provide additional geotechnical and materials testing services. Geotechnical engineering services may include the review of the contract plans and specifications to evaluate their conformance to the recommendations contained in this report. We can also inspect and perform compaction and inplace density determinations on fill materials; inspect and log installations of test piles and job piles; perform and evaluate static or dynamic load tests; monitor vibrations; and test and inspect steel, asphalt, and concrete. Eustis Engineering can also perform any other soils

or materials testing services, which will provide quality control during construction and conformance to design specifications.

59. In summary, Eustis Engineering should be retained to monitor all geotechnical related work performed by the contractor. If construction problems arise, Eustis Engineering should be notified to participate in the development of solutions. This participation permits the geotechnical engineer to evaluate the effects of unanticipated conditions and propose solutions on the geotechnical design assumptions particular to the project. The design geotechnical engineer may also be able to judge how site-specific soil and groundwater conditions will affect the success of a proposed construction alternative.

LIMITATIONS

60. Eustis Engineering has provided engineering services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee is expressed or implied.

61. Eustis Engineering has prepared this report in accordance with generally accepted geotechnical engineering practices for the exclusive use of TGMC for specific application to the subject site. In the event of any changes in the nature, design, or location of the proposed construction, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed, and the conclusions of this report are modified and verified in writing by Eustis Engineering. Should TGMC want to provide these data to be used by anyone other than TGMC, they shall seek written permission from Eustis Engineering, and the user must contact Eustis Engineering for

interpretation of data and to secure other information which may be pertinent to the project.

62. The analyses and recommendations contained in this report are based, in part, on data obtained from soil borings, laboratory testing, and CPTs performed for the subject project. The boring logs and CPT records are considered representative of subsurface conditions at the boring/CPT locations on the dates completed. No warranty is given that the boring logs or CPT records are representative of subsurface conditions at other locations or times. The nature and extent of variations in subsurface conditions, between and away from the boring/CPT locations, may not become evident until construction. If such variations appear, it will be necessary to reevaluate the recommendations contained in this report.

63. Recommendations and conclusions contained within this report are to some degree subjective having partial basis in engineering judgement and experience particular to the design engineer. For this reason, this report should not be included in its entirety in the contract plans and specifications without addressing the limitations of its use. However, the results of the soil borings, laboratory tests, and CPTs contained in Appendices I and II of this report may be included in the plans and specifications. The construction contractor is obliged to make an independent interpretation of subsurface conditions at the site and their potential impact on means and methods used to achieve the plans and specifications.

64. This report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the project engineer to ensure they are incorporated into the plans and

specifications for the project. The owner or the owner's representative also has the responsibility to take the necessary steps to confirm the general contractor and all subcontractors follow such recommendations. It is further understood the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

65. Eustis Engineering should be provided the opportunity for a general review of the design plans and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Eustis Engineering is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of or failure to implement our recommendations.

66. The scope of our service does not include an environmental assessment or an investigation for the presence or absence of wetlands and hazardous or toxic materials in the soil; surface water; groundwater; or air on, below, or adjacent to the subject property. Furthermore, the scope of service does not include the investigation or detection of biological pollutants at the site. The term "biological pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, and the byproducts of any such biological organisms.

SATELLITE IMAGERY DATED: 31 JANUARY 2024

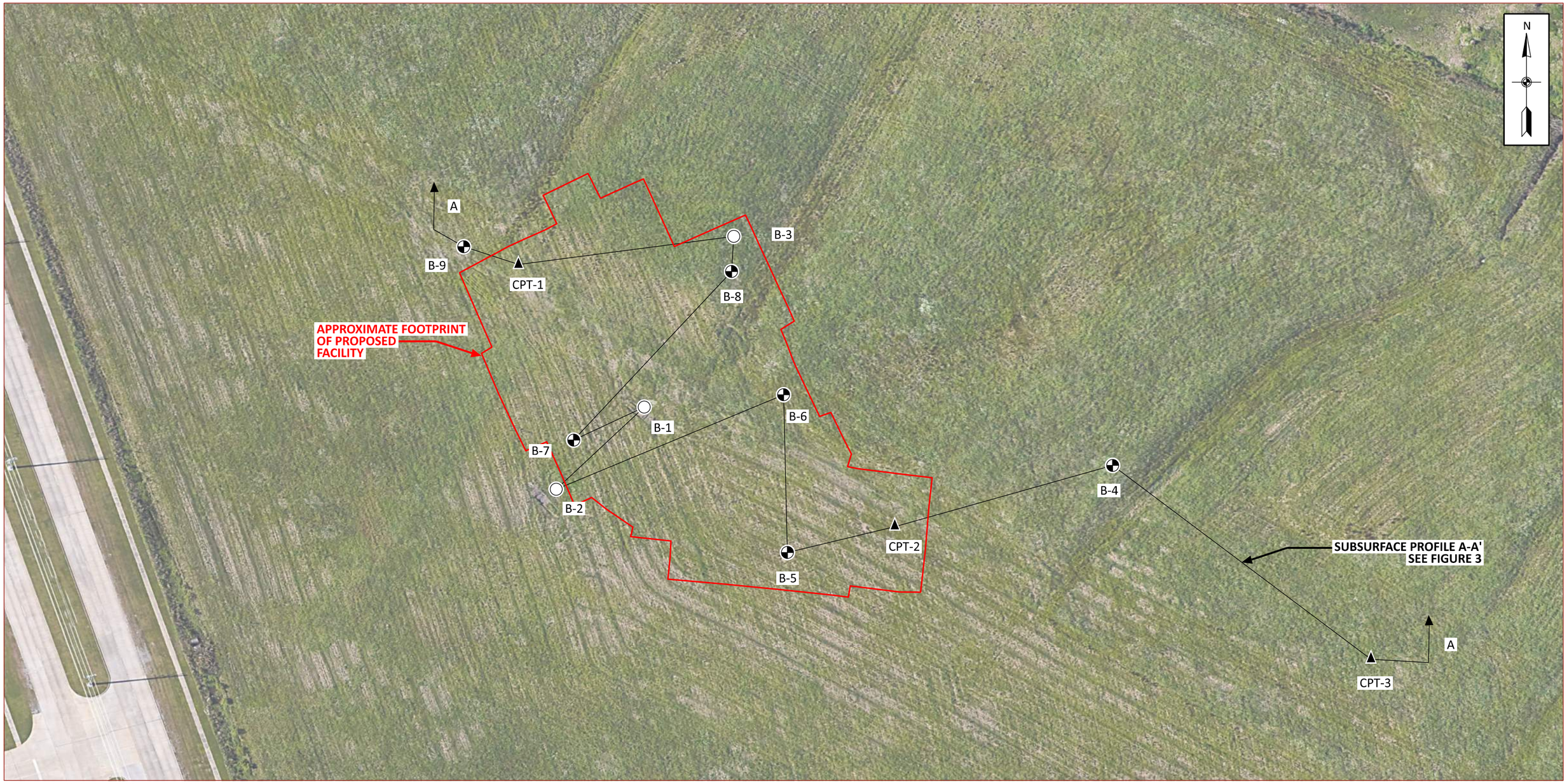
NOT TO SCALE

SITE VICINITY

TERREBONNE GENERAL MEDICAL CENTER
SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.C.C.	JOB NO.: 24717.02
CHECKED BY: A.E.S.	DATE: 25 APR 2024
CADD FILE: VICINITY.DGN	FIGURE 1



SATELLITE IMAGERY DATED: 31 JANUARY 2024

NOT TO SCALE

- DENOTES LOCATIONS OF UNDISTURBED SOIL BORINGS UNDER EUSTIS ENGINEERING PROJECT NO. 24717.02 DRILLED BETWEEN 14 FEBRUARY AND 16 MARCH 2024.
- DENOTES LOCATIONS OF UNDISTURBED SOIL BORINGS UNDER EUSTIS ENGINEERING PROJECT NO. 24717 DRILLED BETWEEN 27 AND 31 JANUARY 2022.
- DENOTES LOCATIONS OF CONE PENETRATION TESTS PERFORMED UNDER EUSTIS ENGINEERING PROJECT NO 24717 ON 31 JANUARY 2022.

EXPLORATION LOCATION PLAN

TERREBONNE GENERAL MEDICAL CENTER
SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.C.C.	JOB NO.: 24717.02
CHECKED BY: A.E.S.	DATE: 25 APR 2024
CADD FILE: LOCATION.DGN	FIGURE 2

B-9 (24717.02)
15 MAR 24
29.61083 -90.76500

CPT-1 (24717)
31 JAN 22
29.61088 -90.76511

B-3 (24717)
28 JAN 22
29.61098 -90.76461

B-8 (24717.02)
13 MAR 24
29.61091 -90.76463

B-7 (24717.02)
21 FEB 24
29.61053 -90.76503

B-1 (24717)
27 JAN 22
29.61064 -90.76473

Sleeve Stress
f_s (ksf)
1 0.8 0.6 0.4 0.2

Tip Resistance
q_t (tsf)
50 100 150 200 250

0 40 80 120 160
Pore Pressure
u_2 (psi)

DEPTH BELOW EXISTING GROUND SURFACE IN FEET

0
30
60
90
120
150
180
210

WASH

(30)
(72)
(66)
(61)

(17)
(22)
(25)
(28)
747

WASH

(16)
(23)
(60)
(50/5")

WASH

(13)
(12)
(28)
(64)
(51)

(14)
(20)
(20)
(24)

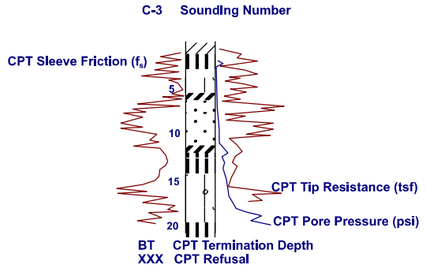
CPT MATERIAL GRAPHICS

- SENSITIVE FINE GRAINED
- ORGANIC SOILS, PEATS
- CLAY
- SILTY CLAY TO CLAY
- CLAYEY SILT TO SILTY CLAY
- SANDY SILT TO CLAYEY SILT
- SILTY SAND TO SANDY SILT
- SAND TO SILTY SAND
- SAND
- GRAVELLY SAND TO SAND
- VERY STIFF FINE GRAINED (*)
- SAND TO CLAYEY SAND (*)

* OVERCONSOLIDATED OR CEMENTED

Robertson et al (1986) q_c vs Rf

ELECTRONIC CONE PENETRATION TEST SOUNDINGS



BORING MATERIAL GRAPHICS

- CLAY
- SANDY CLAY
- SAND
- SILTY SAND
- SILT
- SANDY SILT
- CLAYEY SILT
- ORGANIC CLAY
- WOOD
- SHELLS
- USCS Lean Clay

NOTES:

1. THE NUMBERS TO THE RIGHT OF THE BORING LOGS REPRESENT THE RESULTS OF THE STANDARD PENETRATION TESTS.

SUBSURFACE SOIL PROFILE

TERREBONNE GENERAL MEDICAL CENTER
SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.C.C.	JOB NO.: 24717.02
CHECKED BY: A.E.S.	DATE: 25 APR 2024
CADD FILE: PROFILE.DGN	FIGURE 3 (SHEET 1 OF 2)

B-2 (24717)
31 JAN 22
29.61036 -90.76502

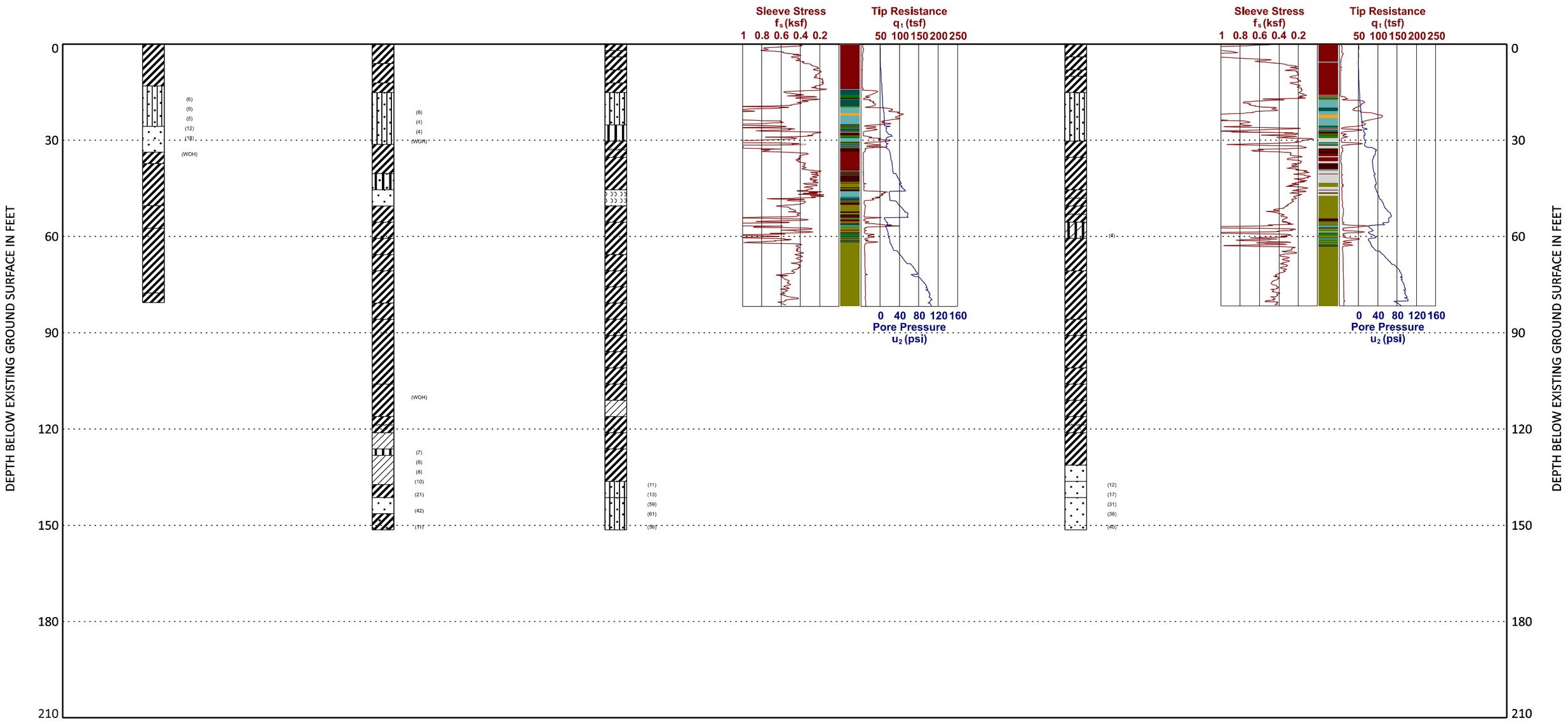
B-6 (24717.02)
27 FEB 24
29.61058 -90.76448

B-5 (24717.02)
18 FEB 24
29.61023 -90.76448

CPT-2 (24717)
31 JAN 22
29.61029 -90.76424

B-4 (24717.02)
14 FEB 24
29.61052 -90.76376

CPT-3 (24717)
31 JAN 22
29.60998 -90.76312



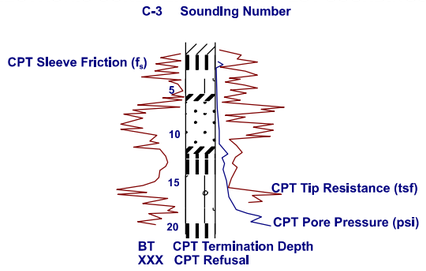
CPT MATERIAL GRAPHICS

- SENSITIVE FINE GRAINED
- ORGANIC SOILS, PEATS
- CLAY
- SILTY CLAY TO CLAY
- CLAYEY SILT TO SILTY CLAY
- SANDY SILT TO CLAYEY SILT
- SILTY SAND TO SANDY SILT
- SAND TO SILTY SAND
- SAND
- GRAVELLY SAND TO SAND
- VERY STIFF FINE GRAINED (*)
- SAND TO CLAYEY SAND (*)

* OVERCONSOLIDATED OR CEMENTED

Robertson et al (1986) q_c vs Rf

ELECTRONIC CONE PENETRATION TEST SOUNDINGS



BORING MATERIAL GRAPHICS

- CLAY
- SANDY CLAY
- SAND
- SILTY SAND
- SILT
- SANDY SILT
- CLAYEY SILT
- ORGANIC CLAY
- WOOD
- SHELLS
- USCS Lean Clay

NOTES:

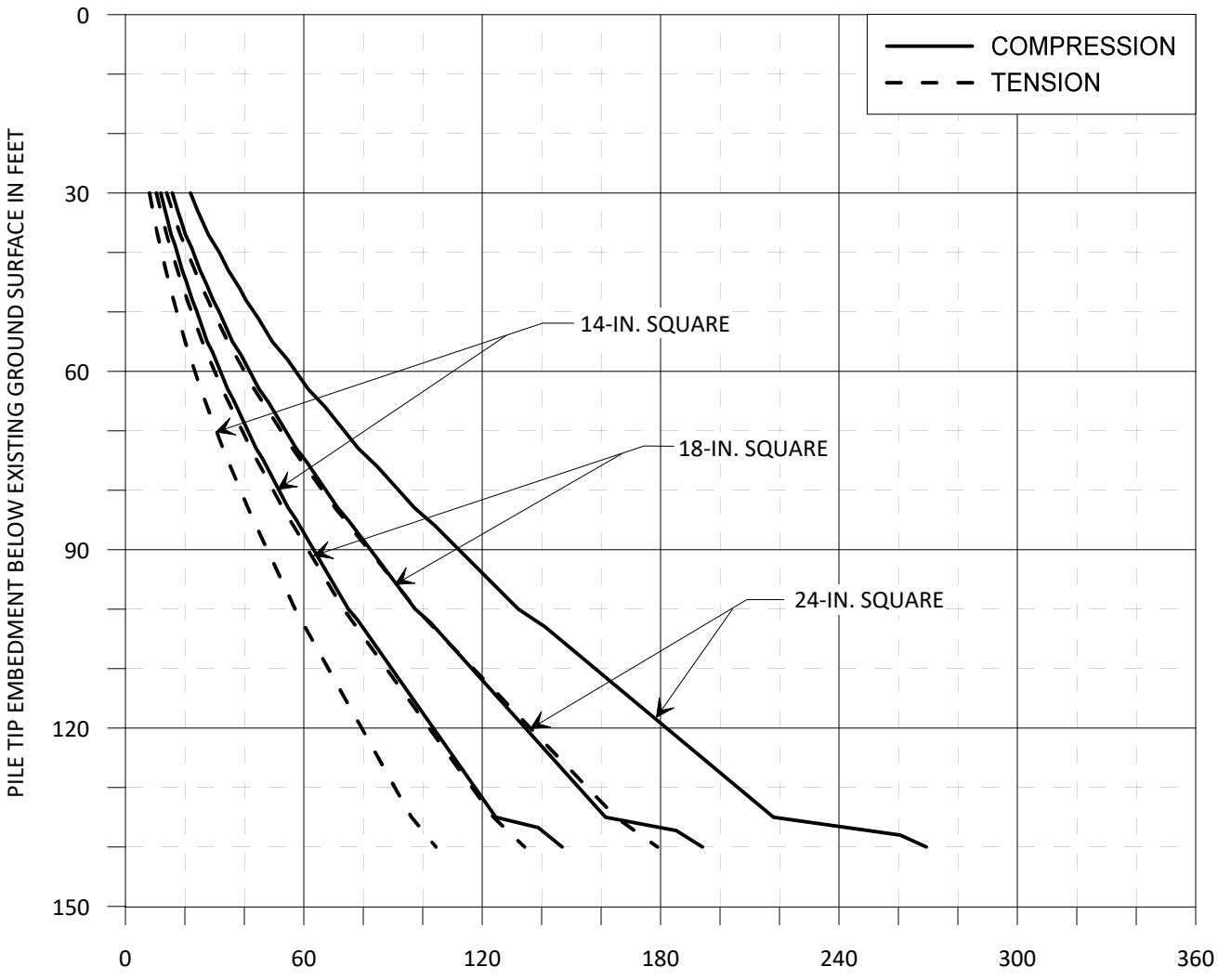
1. THE NUMBERS TO THE RIGHT OF THE BORING LOGS REPRESENT THE RESULTS OF THE STANDARD PENETRATION TESTS.

SUBSURFACE SOIL PROFILE

TERREBONNE GENERAL MEDICAL CENTER
SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.C.C.	JOB NO.: 24717.02
CHECKED BY: A.E.S.	DATE: 25 APR 2024
CADD FILE: PROFILE.DGN	FIGURE 3 (SHEET 2 OF 2)



NOTES:

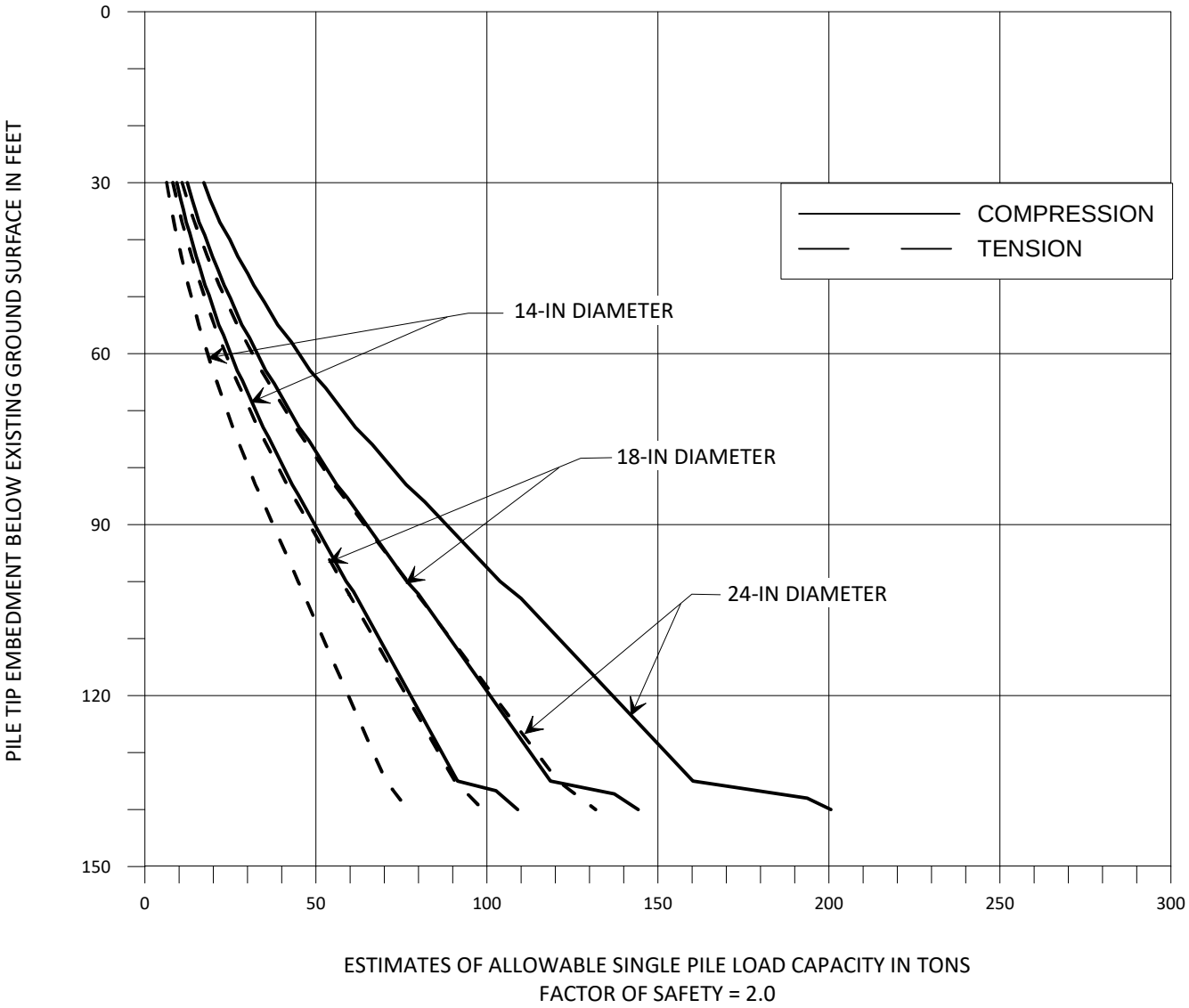
1. PILE LOAD CAPACITY ESTIMATES PRESENTED ON THIS FIGURE DO NOT INCLUDE THE WEIGHT OF THE PILE. A NET LOAD OF 45 PCF MAY BE USED FOR THE WEIGHT OF THE CONCRETE (WEIGHT OF THE CONCRETE MINUS THE WEIGHT OF THE SOIL REMOVED).
2. PILES ASSUMED TO BE INSTALLED BY IMPACT DRIVING EQUIPMENT WITHOUT ASSISTANCE FROM JETTING OR VIBRATORY EQUIPMENT.
3. USE OF A FACTOR OF SAFETY OF 2.0 ASSUMES A STATIC LOAD TEST WILL BE PERFORMED.
4. SELECTION OF PILE TIP EMBEDMENT SHOULD ALSO CONSIDER SETTLEMENT POTENTIAL ESTIMATES.
5. ESTIMATES INCLUDE CAPACITY REDUCTION FOR 2-FT CUTOFF AT THE PILE BUTT.

ESTIMATES OF SINGLE PILE ALLOWABLE LOAD CAPACITY
SQUARE, PRECAST CONCRETE PILES

TERREBONNE GENERAL MEDICAL CENTER
SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING SINCE 1946

DRAWN BY: A.E.S.	JOB NO.: 24717.02
CHECKED BY: P.A.T.	DATE: 18 APRIL 2024
FILE NAME: SPC APLC	FIGURE 4



NOTES:

1. PILES ASSUMED TO BE INSTALLED BY IMPACT DRIVING EQUIPMENT WITHOUT ASSISTANCE FROM JETTING OR VIBRATORY EQUIPMENT.
2. USE OF A FACTOR OF SAFETY OF 2.0 ASSUMES A STATIC LOAD TEST WILL BE PERFORMED.
3. SELECTION OF PILE TIP EMBEDMENT SHOULD ALSO CONSIDER SETTLEMENT POTENTIAL ESTIMATES.
4. ESTIMATES INCLUDE CAPACITY REDUCTION FOR 2-FT CUTOFF AT THE PILE BUTT.

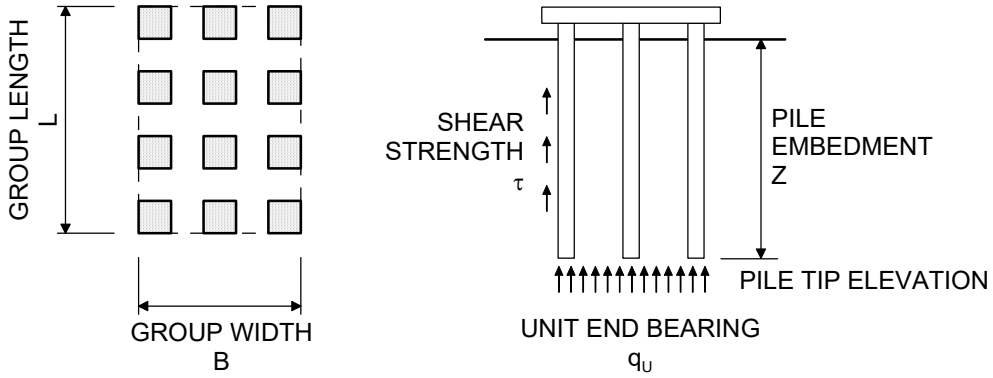
ESTIMATES OF SINGLE PILE ALLOWABLE LOAD CAPACITY
OPEN-END, STEEL PIPE PILES

TERREBONNE GENERAL MEDICAL CENTER
SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: P.T.D.	JOB NO.: 24717.02
CHECKED BY: P.A.T.	DATE: 24 APRIL 2024
FILE NAME: OSP.GRF	FIGURE 5

Load Capacity of Rows or Groups of Piles



PLAN VIEW **ELEVATION VIEW**

The capacity of a row or group of piles may be equal to or less than the sum of the individual load capacities of piles within the group. The pile row or group may be considered a single equivalent pier, in which case the row or group capacity may be investigated using the following formula.

$$P_{GROUP} = \frac{(2L+2B)(\tau)(z)}{FS_{SIDE}} + \frac{(B)(L)(q_U)}{FS_{BASE}}$$

Where:

B	=	The width of the pile group in plan dimension.
L	=	The length of the pile group in plan dimension.
Z	=	The embedded pile length.
τ	=	The average unit shear strength acting on the embedded pile length.
q_U	=	The ultimate unit end-bearing pressure appropriate for the pile group.
FS_{SIDE}	=	A factor of safety against mobilization of the ultimate skin friction, typically 2.
FS_{BASE}	=	A factor of safety against mobilization of the ultimate end bearing, usually at least 3.

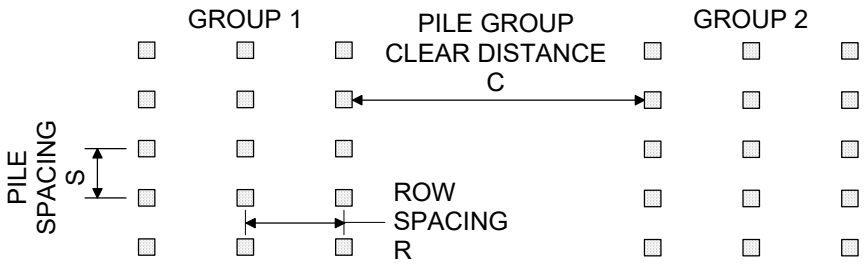
Notes:

(1) The average unit shear strength acting on the embedded pile length may be taken as the weighted average value of undrained shear strength (or undrained cohesion) acting over that length for assessments of the short term load capacity of the group.

(2) For assessments of the short term load capacity of the group, the ultimate end bearing is commonly estimated by multiplying an undrained shear strength (or undrained cohesion) by a bearing capacity factor, which typically varies between 5 and 6. The appropriate undrained shear strength and bearing capacity factor should consider the width and length of the pile group and the presence of any weak strata beneath the pile tips. In general, the unit end bearing pressure applicable to the pile group is not the same as the unit end bearing pressure used to estimate the load capacity of a single pile.

(3) The factor of safety against base failure should consider that large deformations may be required to mobilize the ultimate end bearing soil pressure estimated for the pile group.

Spacing of Pile Groups and Spacing of Piles Within Rows or Groups



Piles should be arranged to provide a minimum center-to-center spacing, S, within rows or groups. This minimum recommended spacing may be taken as the largest value from the following criteria:

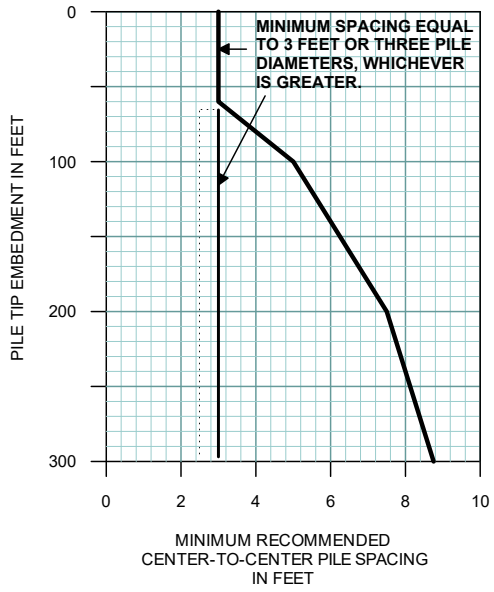
$$S = \frac{L_1}{20} + \frac{L_2}{40} + \frac{L_3}{80} \text{ ,or}$$

$$S = 3B \text{,or}$$

$$S = 3 \text{ feet}$$

where S = Center-to-center pile spacing, as illustrated above,
L_1 = Pile embedment up to 100 feet,
L_2 = Pile embedment between 100 and 200 feet,
L_3 = Pile embedment between 200 and 300 feet, and
B = Pile outside diameter or side dimension

These criteria can be presented graphically as follows:



In addition, rows of single piles should provide a minimum center-to-center spacing, R, that is at least as large as the center-to-center pile spacing, S. Finally, individual pile groups should be arranged to provide a clear group spacing, C, equal to twice the largest dimension of the larger pile group. It should be noted that pile spacings greater than the minimum values presented above may be required to minimize the influence of individual piles on each other with respect to lateral load resistance and settlement or to ensure pile group capacity is adequate when investigated for group perimeter shear.

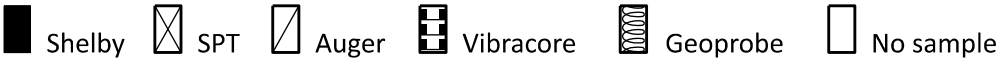
APPENDIX I

EUSTIS ENGINEERING SINCE 1946

LEGEND AND NOTES FOR LOG OF BORING AND TEST RESULTS

PP Pocket penetrometer: Resistance in tons per square foot

SPT Standard Penetration Test: Number of blows of a 140-lb hammer dropped 30 inches required to drive 2-in. O.D., 1.4-in. I.D. sampler a distance of 1 foot into the soil after first seating it 6 inches. Values shown have not been corrected.

SPLR Type of Sampling  Shelby, SPT, Auger, Vibracore, Geoprobe, No sample

SYMBOL Clay, Silt, Sand, Peat/Humus, Shells, Stone/Gravel

Predominant type shown heavy; modifying type shown light

USC Unified Soil Classification

DENSITY Unit weight in pounds per cubic foot

SHEAR TESTS

TYPE

- UC Unconfined compression shear
- OB Unconsolidated undrained triaxial compression shear on one specimen confined at the approximate overburden pressure
- UU Unconsolidated undrained triaxial compression shear
- ϕ Angle of internal friction in degrees
- c Cohesion in pounds per square foot

ATTERBERG LIMITS

- LL Liquid Limit
- PL Plastic Limit
- PI Plasticity Index

OTHER TESTS

- CON Consolidation
- -#200 Percent passing a U.S. No. 200 sieve
- SV Particle size distribution (sieve only)
- PD Particle size distribution (sieve and hydrometer)
- k Coefficient of permeability in centimeters per second
- SP Swelling pressure in pounds per square foot

Other laboratory test results reported on separate figures

GENERAL NOTES

(1) If a ground water depth is shown on the boring log, these observations were made at the time of drilling and were measured below the existing ground surface. These observations are shown on the boring logs. However, ground water levels may vary due to seasonal fluctuations and other factors. If important to construction, the depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

(2) While the individual logs of borings are considered to be representative of subsurface conditions at their respective locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-1

Project No: 24717
Date: 01/27/2022
Latitude: 29.61064°
Longitude: -90.76473°

Water Depth: See Text
Total Depth: 100.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0					Moist, soft gray & tan FAT CLAY w/trace of silt pockets & roots	CH	PB-1	0											
	0.50						2	2	43	77	110	UC	--	398	97	29	68		
5	0.50						3	5	58	66	104	UC	--	324					
	0.25				w/few silt pockets, trace of roots, & concretions		4	8	56	63	99	UC	--	366	80	25	55		
10	0.25				Moist, loose gray fine SANDY SILT w/some clay pockets	ML	5	11	32										
		14			Wet, medium dense gray fine SILTY SAND w/clay & trace of roots	SM	PB-6	13.5	35										
15		20					PB-7	16.5											
20		20					PB-8	19.5	28										
		24					PB-9	22.5	28										
25																			
	0.50				Moist, soft gray & brown ORGANIC CLAY w/few shell fragments	OH	10	28	149	31	78	OB	0	356					
30																			
	0.25				Moist, very soft gray FAT CLAY w/few silt pockets	CH	11	33	48	70	103	UC	--	218					
35																			
	0.25				Moist, soft gray LEAN CLAY	CL	12	38	41	78	110	UC	--	370					
40																			
	0.25				Moist, soft gray FAT CLAY w/trace of silt pockets	CH	13	43	50										
45																			
	0.50				w/trace of silt pockets & lenses		14	48	60	62	98	OB	0	472					
50																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-1

Project No: 24717
Date: 01/27/2022
Latitude: 29.61064°
Longitude: -90.76473°

Water Depth: See Text
Total Depth: 100.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, soft gray FAT CLAY w/trace of concretions & decayed wood	CH													
	0.50						15	53	70	57	96	OB	0	525					
55					Moist, soft gray LEAN CLAY	CL													
	0.50						16	58	37										
60					Moist, soft gray FAT CLAY w/trace of silt pockets	CH													
	0.75						17	63	46	71	104	UC	--	304					
65					Moist, medium stiff gray FAT CLAY w/trace of silt pockets & lenses	CH													
	0.50						18	68	54	68	105	OB	0	942					
70																			
	0.75						19	73	55										
75																			
	0.75						20	78	56	67	104	UC	--	561					
80																			
	0.50						21	83	58										
85																			
	0.50						22	88	51	67	102	UC	--	582					
90																			
	0.50						23	93	48										
95																			
	0.75				Moist, stiff gray FAT CLAY w/trace of silt pockets & lenses	CH	24	98	51	71	107	OB	0	1020					
100																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61036°
Longitude: -90.76502°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0					Moist, extremely soft to very soft gray & tan FAT CLAY w/few concretions & silt pockets	CH	PB-1	0	44										
	0.50						2	2	54	66	101	UC	--	118					
5	0.00				w/few silt pockets & trace of roots		3	5	62	63	102	UC	--	73	79	26	53		
	0.25				w/few decayed wood, organic matter, & roots		4	8	59	65	103	UC	--	108					
10	0.00				w/few silt lenses & pockets, wood, & trace of roots		5	11	60	64	103	UC	--	137					
					Moist to wet, loose gray fine SILTY SAND	SM	6	14	27										
15		6			w/trace of clay		PB-7	16.5	31										
		9					PB-8	19.5											
20		5					PB-9	22.5	28										
		12			Moist, medium dense gray & brown POORLY GRADED SAND w/trace of silt & organic matter	SP	PB-10	25.5											
25		18					PB-11	28.5	25										
30		WOH			Moist, very soft gray FAT CLAY w/few organic matter & roots	CH	PB-12	33.5	58						81	21	60		
35	0.75				Moist, soft to medium stiff gray FAT CLAY w/trace of silt pockets & decayed wood	CH	13	38	46	74	108	OB	0	614					
40	0.00						14	43	53	69	106	OB	0	464					
45	0.00				w/few silt lenses & layers		15	48	60	63	101	UC	--	163					
50																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61036°
Longitude: -90.76502°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, soft gray FAT CLAY w/few silt lenses & layers	CH													
	0.00						16	53	43	74	106	UC	--	469					
55					Moist, medium stiff gray FAT CLAY w/few fine sand pockets	CH													
	0.00						17	58	59	63	100	UC	--	773					
60																			
	0.50						18	63	60	64	103	OB	0	760					
65																			
	0.50				w/trace of silt pockets		19	68	58										
70																			
	0.50				w/trace of silt pockets & lenses		20	73	61	64	103	UC	--	708					
75																			
	0.50				Moist, stiff gray FAT CLAY w/trace of silt pockets	CH	21	78	64	61	100	OB	0	1128					
80																			
85																			
90																			
95																			
100																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-3

Project No: 24717
Date: 01/28/2022
Latitude: 29.61098°
Longitude: -90.76461°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Other Tests
0					Moist, medium stiff gray & brown FAT CLAY w/few decayed wood, organic matter & trace of roots	CH	PB-1	0	46						99	26	73	
	1.25						2	2	49	71	106	UC	--	575				
5	0.50						3	5	48	71	105	UC	--	623	77	25	52	
	0.50				Moist, soft gray FAT CLAY w/little decayed wood & roots	CH	4	8	66	60	100	OB	0	410				
10	0.25				Moist, extremely soft gray FAT CLAY w/little decayed wood & roots	CH	5	11	88	49	93	UC	--	49				
	0.25						6	14	89	48	90	UC	--	116				
15		17			Wet, medium dense gray fine SILTY SAND w/trace of organic matter	SM	PB-7	15.5	26									
		22					PB-8	18.5	27									
20		25					PB-9	21.5										
25		28					PB-10	24.5	28									
	0.50				Moist, medium stiff brown ORGANIC CLAY w/few decayed wood	OH	11	28	117	39	84	OB	0	747				
30	0.50				Moist, soft gray LEAN CLAY	CL	12	33	36									
35	0.50				Moist, soft gray FAT CLAY w/few silt pockets & trace of concretions	CH	13	38	50	71	107	UC	--	331				
40	0.50				Wet, soft gray LEAN CLAY	CL	14	43	37	80	110	OB	0	250	35	19	16	
45	1.50				Moist, medium stiff gray & brown ORGANIC CLAY w/some decayed wood, wood layers, & trace of clay lenses	OH	15	48	103									
50																		

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

Boring: B-3

Project No: 24717
Date: 01/28/2022
Latitude: 29.61098°
Longitude: -90.76461°

Water Depth: See Text
Total Depth: 80.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, medium stiff gray & brown ORGANIC CLAY w/some decayed wood, wood layers, & trace of clay lenses	OH													
	1.25						16	53	104	42	87	UC	--	631					
55																			
	0.75						17	58	104										
60																			
	0.50				Moist, soft to medium stiff gray FAT CLAY	CH	18	63	60	62	99	UC	--	308					
65																			
	0.50				w/few silt pockets		19	68	49	69	103	UC	--	504					
70																			
	0.50				w/few concretions		20	73	57	66	103	OB	0	679					
75																			
	0.50				w/trace of silt pockets		21	78	63										
80																			
85																			
90																			
95																			
100																			

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE STANDARD BORING LOG 24717.GPJ 3/10/22

NOTES:

EUSTIS
ENGINEERING
SINCE 1946

CONE PENETRATION
SOIL BEHAVIOR TYPE LEGEND

*OVERCONSOLIDATED OR CEMENTED

EUSTIS ENGINEERING SINCE 1946

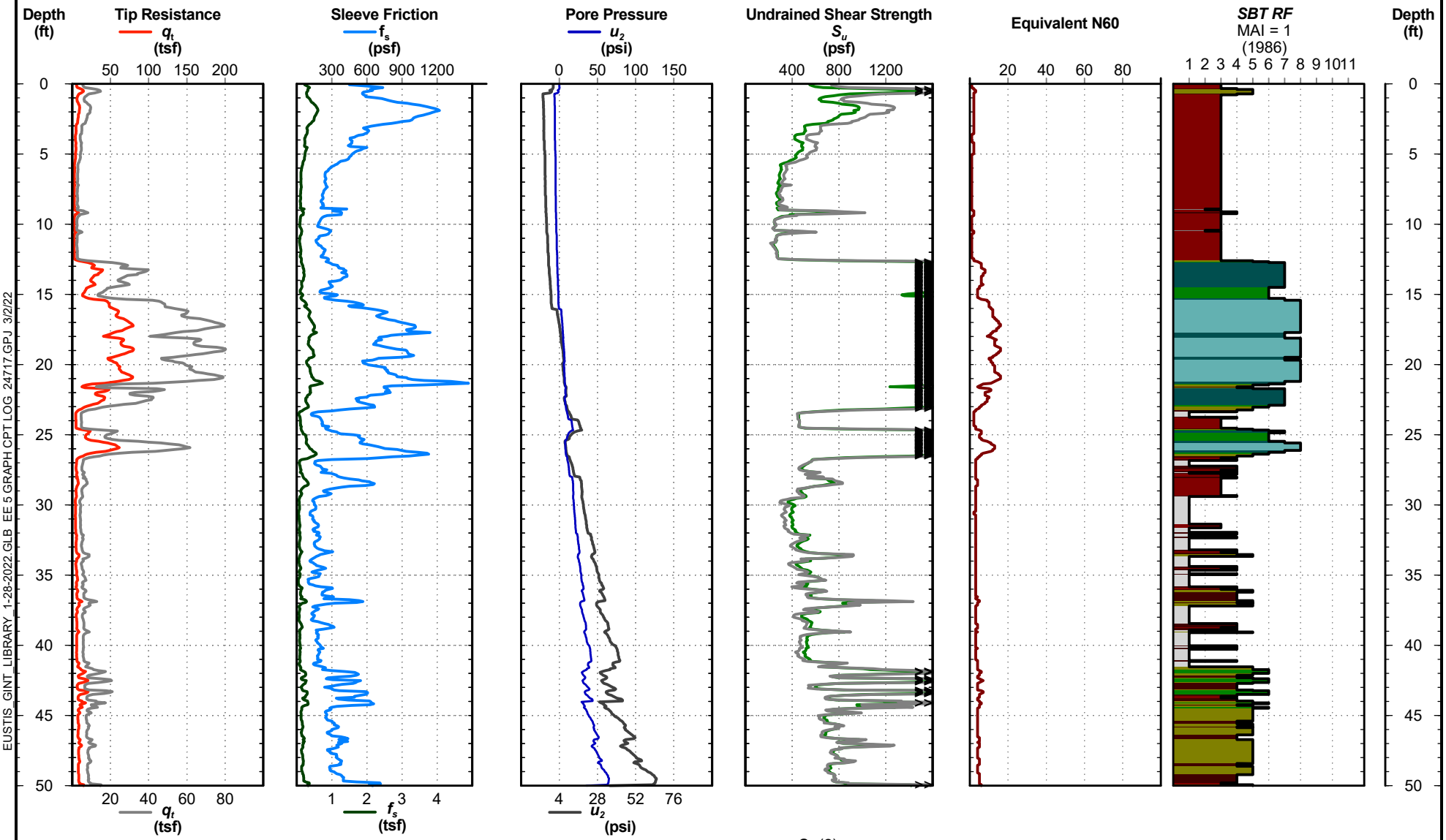
CONE PENETRATION TEST

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-1

Project No: 24717
Date: 01/31/2022
Latitude: 29.61088°
Longitude: -90.76511°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.3 ft
Operator: G. Reitmeyer



EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-1.cpt

CONE PENETRATION TEST

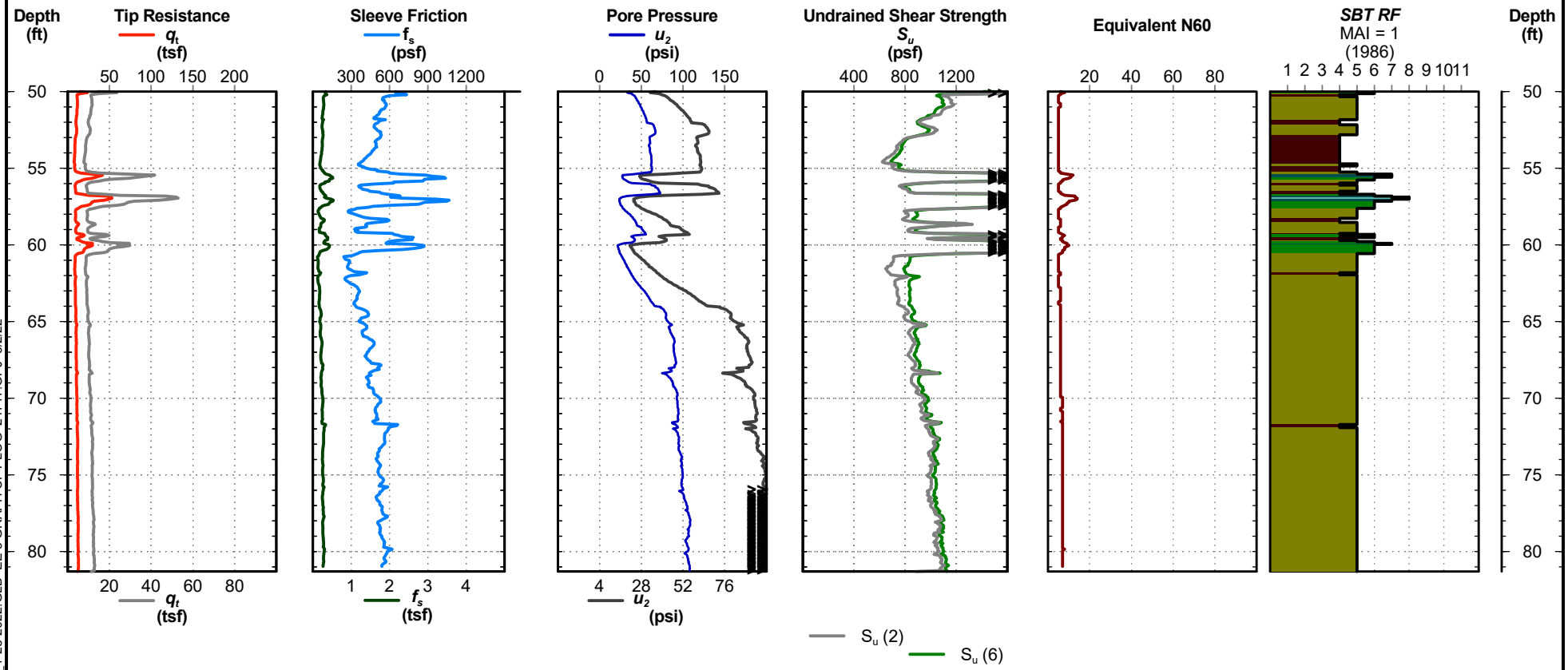
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-1

Project No: 24717
Date: 01/31/2022
Latitude: 29.61088°
Longitude: -90.76511°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.3 ft
Operator: G. Reitmeyer



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-1.cpt

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

CONE PENETRATION TEST

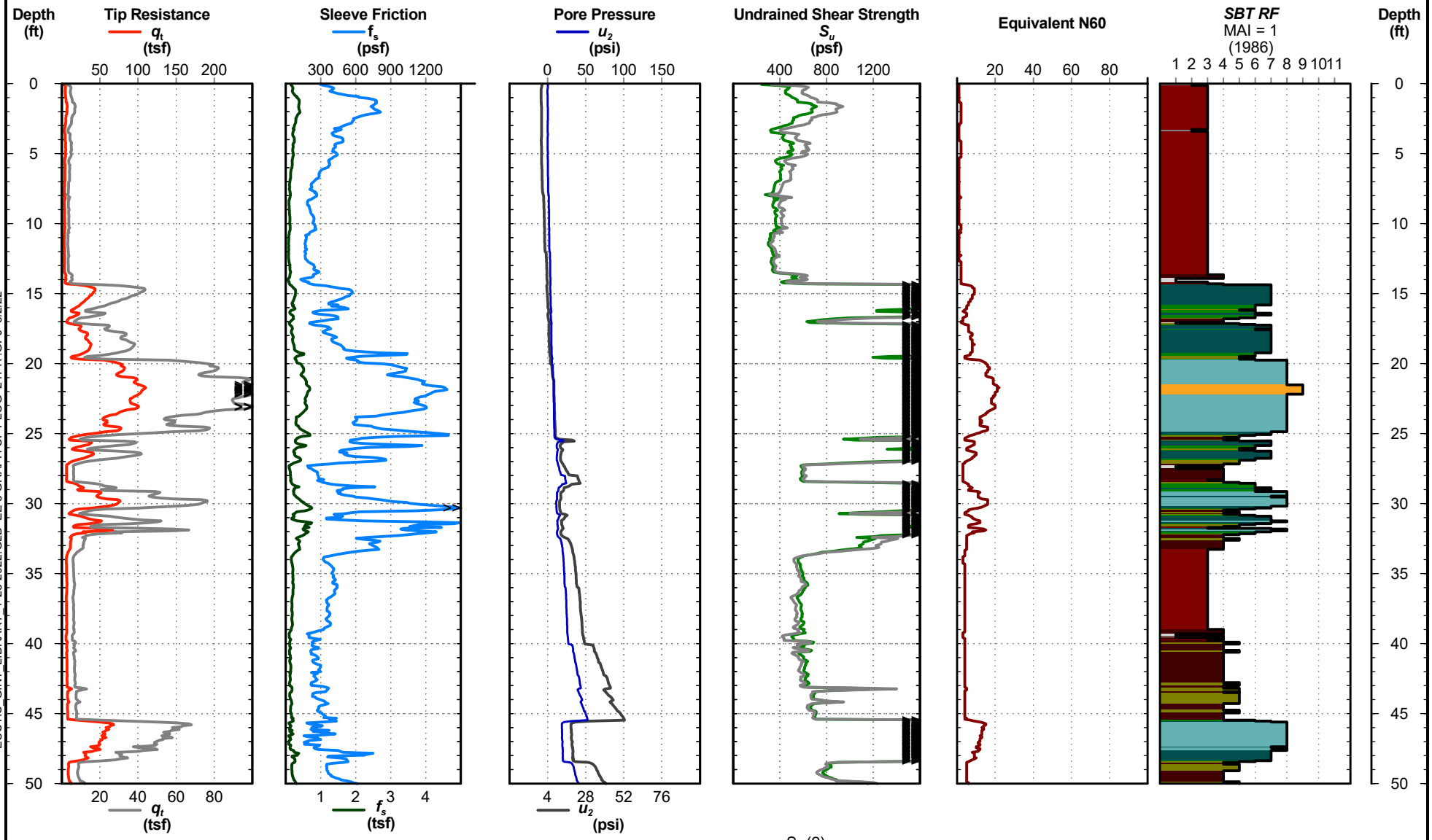
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61029°
Longitude: -90.76424°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.1 ft
Operator: G. Reitmeyer



EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

CONE PENETRATION TEST

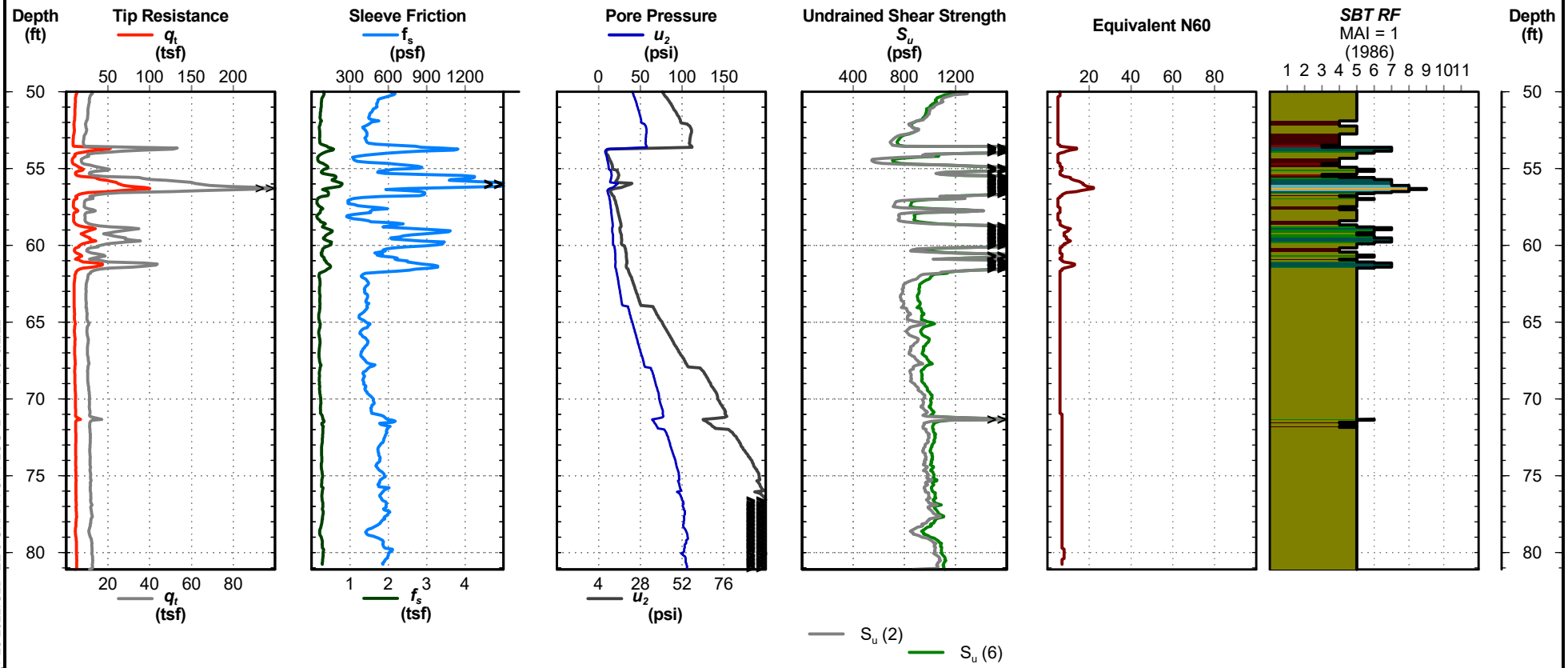
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-2

Project No: 24717
Date: 01/31/2022
Latitude: 29.61029°
Longitude: -90.76424°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.1 ft
Operator: G. Reitmeyer



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-2.cpt

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

CONE PENETRATION TEST

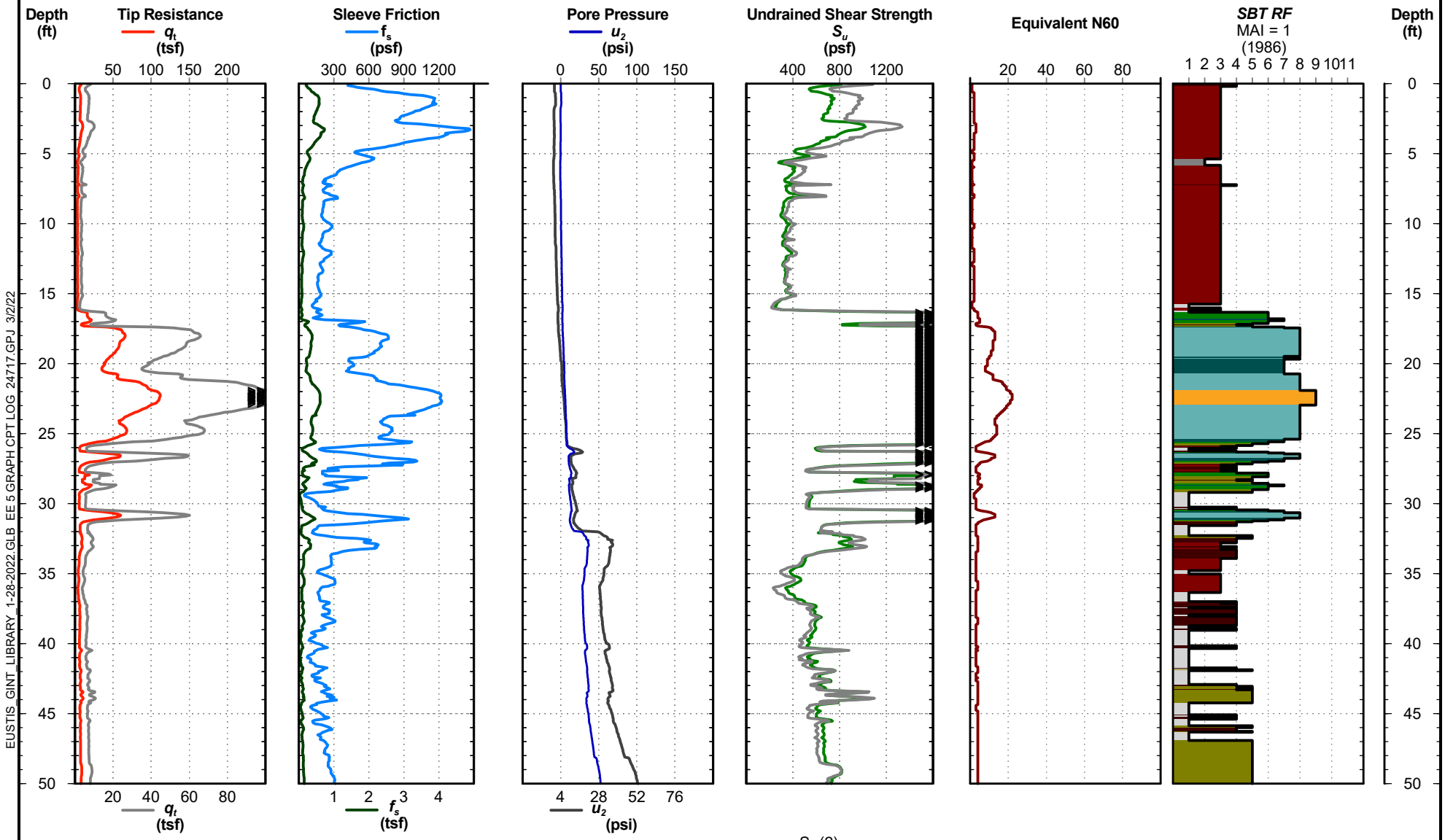
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-3

Project No: 24717
Date: 01/31/2022
Latitude: 29.60998°
Longitude: -90.76312°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.0 ft
Operator: G. Reitmeyer



EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

CONE PENETRATION TEST

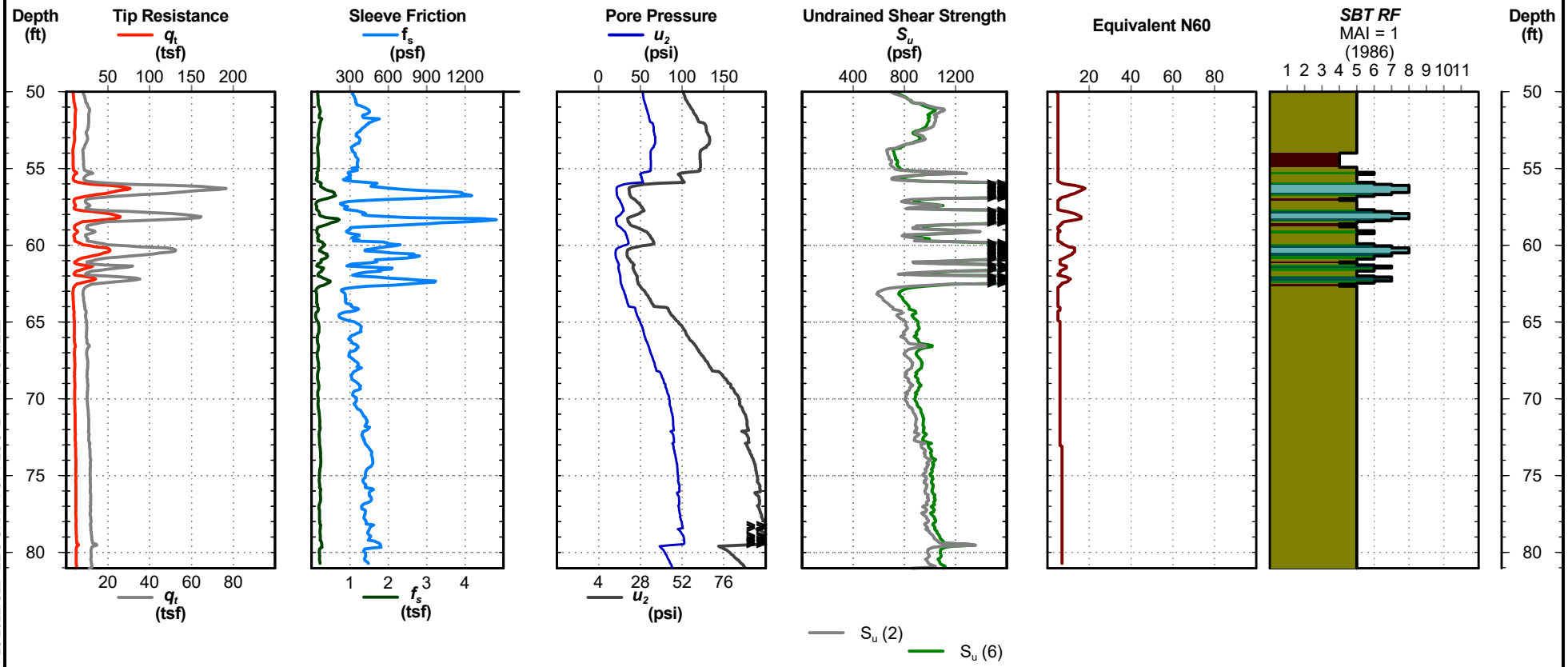
EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Proposed Health and Wellness Center
Houma, Louisiana
SEF Project No. 6925

CPT-3

Project No: 24717
Date: 01/31/2022
Latitude: 29.60998°
Longitude: -90.76312°
CPT ID: 5500

Est. Water Depth: 4 ft.
Total Depth: 81.0 ft
Operator: G. Reitmeyer



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson*et al.*, 1986).
Test performed in general accordance with ASTM D5778-20.

Electronic Filename: 24717CPT-3.cpt

EUSTIS_GINT_LIBRARY_1-28-2022.GLB EE 5 GRAPH CPT LOG 24717.GPJ 3/2/22

CPT Correlations

References are next to the appropriate equation.

General

p_a=atmospheric pressure (for unit normalization)
q_t=corrected cone tip resistance (tsf)
f_s=friction sleeve resistance (tsf)
$R_f = 100\% \cdot (f_s/q_t)$
u_2=pore pressure behind cone tip (tsf)
u_0=hydrostatic pressure

$B_q = (u_2-u_0)/(q_t-\sigma_{vo})$
$Q_t=(q_t-\sigma_{vo})/\sigma'_{vo}$
$F_r=100\% \cdot f_s/(q_t-\sigma_{vo})$
$I_c = ((3.47-\log Q_t)^2 + (\log F_r+1.22)^2)^{0.5}$ 2
$I_{SBT} = ((3.47-\log(q_c/p_a))^2+(\log F_r+1.22)^2)^{0.5}$ 23
$I_{c\ J\&D} = \sqrt{\{3-\log(Q_t\cdot(1-B_q)\}^2 + [1.5+1.3\cdot\log(F_r)]^2}$ 27
$I_{c\ J\&B} = \sqrt{\{3-\log(Q_t\cdot(1-B_q)+1\}^2 + [1.5+1.3\cdot\log(F_r)]^2}$ 28

K_o

K_0 (1) $K_o = (1-\sin\varphi)OCR^{\sin\varphi}$
K_0 (2) $K_o = 0.1(Q_t)$ 1

Stress History

$OCR = \sigma_p'/\sigma'_{vo}$
OCR (1) $\sigma_p' = 0.33(q_t - \sigma_{vo})$ - clays 8
OCR (2) $\sigma_p' = 0.53(u_2 - u_o)$ - clays 9
OCR (3) $\sigma_p' = 0.60(q_t - u_2)$ - clays 9
OCR (4) $OCR = 0.25\ Q_t^{1.25}$ – clays 37
OCR (5) $OCR = \left[\frac{0.192*(q_t/p_a)^{0.22}}{(1-\sin(\phi')\cdot(\sigma'_{v0}/p_a{}^{0.31})}\right]^{\frac{1}{\sin(\phi'-0.27)}}$ – sands 35
OCR (6) $\sigma_p' = .101\cdot p_a{}^{0.102}\cdot G_{max}{}^{0.478}\cdot\sigma'_{v0}{}^{0.420}$ – all soils 36

N-Value

$N_{60} = (q_t/p_a)/[8.5(1-I_c/4.6)]$ 6

Undrained Shear Strength

S_u (1) $S_u = (u_2 - u_o)/N_u$ where $7 \le N_u \le 9$ 10
S_u (2) $S_u = (q_t - \sigma_{vo})/N_{kT}$ where $15 \le N_{kT} \le 20$ 11
S_u (3) $S_u = 0.091 * ((\sigma'_{vo}{}^{0.2}) * (q_t - \sigma_{vo})^{0.8}$ 21
S_u (4) $S_u = (q_c - \sigma_{vo})/N_k$ where $15 \le N_k \le 20$ 11
S_u (5) $S_u = q_t/N_c$ where $XXX \le N_c \le YYY$
S_u (6) $S_u = q_c/N_c$ where $XXX \le N_c \le YYY$

Effective Cohesion

$c' = 0.02 * \sigma_p'$ 38

Drained Friction Angle

φ' (1) $\varphi' = 17.6 + 11.0\text{Log}[q_t/(\sigma_{vo}')^{0.5}]$ 1

φ' (2) $\varphi' = \arctan[0.1 + 0.38\text{Log}(q_t/\sigma_{vo}')]$ 13

φ' (3) $\varphi' = 30.8\text{Log}[(f_s/\sigma_{vo}')+1.26]$ (for clays or sands) 14

φ' (4) $\varphi' = 29.5\ B_q^{0.121}\ (0.256 + 0.33\ B_q + \text{Log}(Q_t))$ 24

Unit Weight

$\rho = \gamma/\gamma_w$

$\rho = 0.8\text{Log}(V_s)$ V_s in m/sec 17

Relative Density and Void Ratio

D_R (1) $D_R = 100(q_{c1}/305)^{1/2}$ where, $q_{c1} = q_c/(\sigma_{vo}')^{1/2}$ 1

D_R (2) $D_R = -1.292 + 0.268\ln(q_c \cdot (\sigma_{vo}'^{-0.5}))$ 18

D_R (3) $D_R = (1/2.41)\cdot\ln(q_{c1}/15.7)$ 3

D_R (4) $D_R = 1/2.91 * \ln((q_c/(61* \sigma'^{0.71}_{vo}))*100$ 20

D_R (5) $D_R = 100*(0.268*\ln((q_t/p_a)/(\sigma'_{vo}/p_a)^{0.5}) - 0.675)$ 34

$e_o = 1.099 - 0.204\log(q_{c1})$ 1

$E_D = 5\ q_t$ $I_D = 2.0 - 0.14(R_f)$ $K_D = E_D/(34.7\cdot I_D\cdot \sigma_{vo}')$

Compressibility

M (1) = $R_m\ E_D$ where R_m= function(I_D, K_D) see the following table 22

$I_D <= 0.6$	$R_M = 0.14 + 2.36 \log K_D$
$I_D >= 3$	$R_M = 0.5 + 2 \log K_D$
$0.6 < I_D < 3$	$R_M = R_{M,D} + (2.5 - R_{M,D})\log K_D$
	$R_{M,D} = 0.14 + 0.15(I_D - 0.6)$
$K_D > 10$	$R_M = 0.32 + 2.18 \log K_D$
$R_M < 0.85$	$R_M = 0.85$

M (2) $M = q_c\cdot 10^{(1.09-0.0075D}R^{)}$ *sands* 1

M (3) $M = 8.25\ (q_t - \sigma_{vo})$ *clays* 1

M (4) $M = \alpha \cdot G_{max}\ where\ 0.02 < \alpha < 2$ and $G_{max}\ is\ from\ Vs$ 33

Rigidity Index

$I_R = exp\left[\left(\frac{1.5}{M} + 2.925\right)\cdot\left(\frac{q_t-\sigma_{vo}}{q_t-u_2}\right) - 2.925\right]$ where $M = 6\sin\emptyset'/(3-\sin\emptyset')$ 39

Sensitivity

S_t (1) $S_t = 7.5/R_f$ 2

S_t (2) $S_t = (q_t - \sigma_{vo})/(15\cdot f_s)$ 2

Fines Content

$FC = [(3.58-\log(q_t))^2+(1.43+\log(R_f))^2]^{1.8}$ 4

$FC = [5.31(I_{cfs})^{2.31}]+9.61$, where $I_{cfs} = [(1.95-\text{Log}Q_t)^2+(\log F_r+1.78)^2]^{0.5}$

Shear Wave Velocity

$V_s(1) = 277 \cdot q_t^{0.13} \cdot {\sigma'_{vo}}^{0.27}$ (sands) - m/s and MPa 29

$V_s(2) = 1.75 \cdot q_t^{0.627}$ (clays) - m/s and kPa 30

$V_s(3) = (10.1 \cdot \log q_t - 11.4)^{1.67} \cdot (\frac{f_s}{q_t} \cdot 100)^{0.3}$ (all soils) – m/s and kPa 31

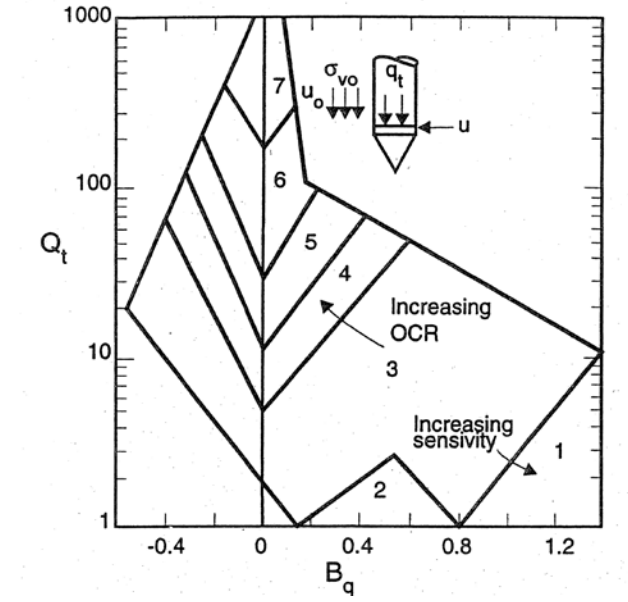
$V_s(4) = 118.8 \cdot \log f_s + 18.5$ (all soils) – m/s and kPa 32

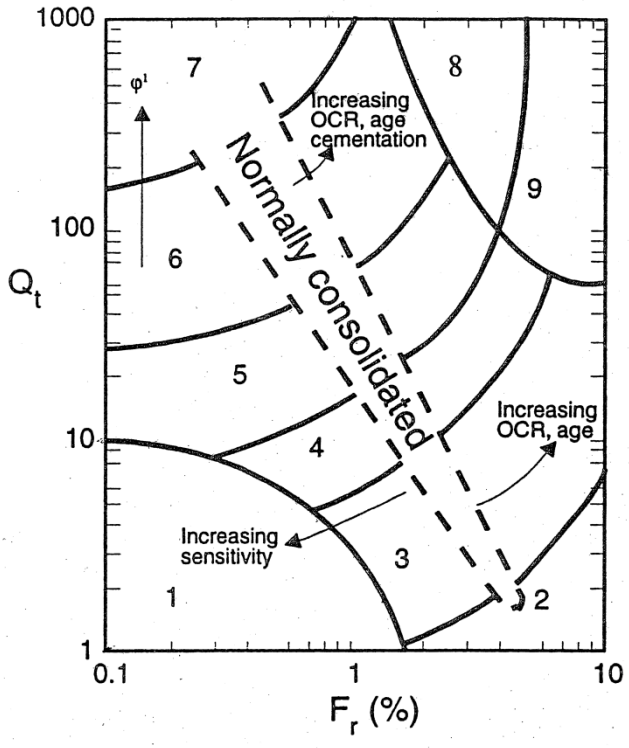
$G_{max} = \rho V_s^2$

Hydraulic Conductivity

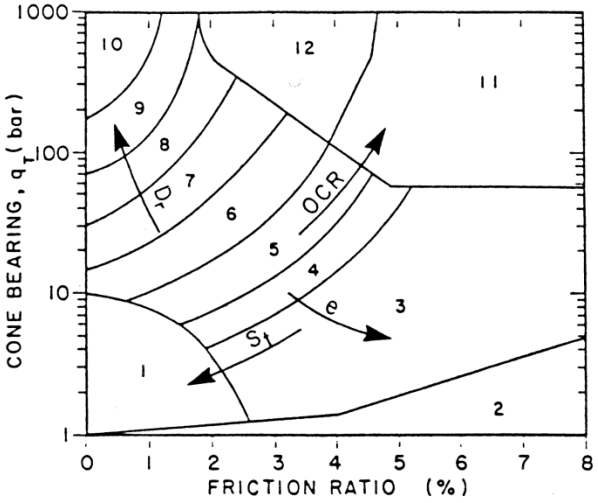
Lookup based on SBT and SBTn (1986 and 1990) 40

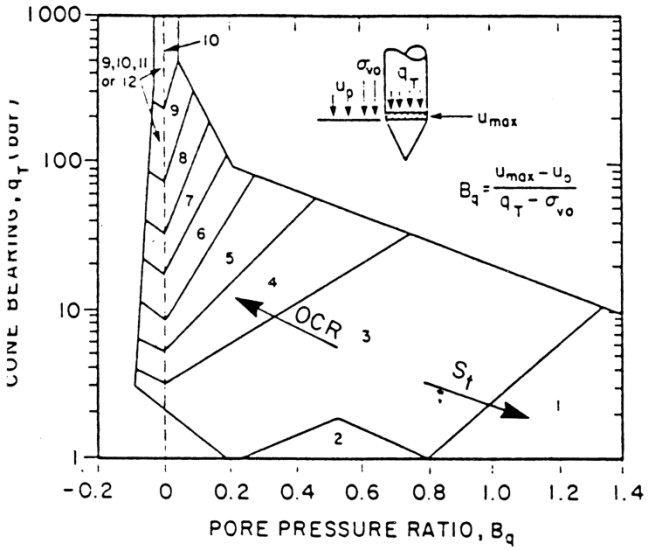
Normalized Soil Behavior Types - Robertson & Campanella (1990)





Non-Normalized Soil Behavior Types – Robertson & Campanella (1986)





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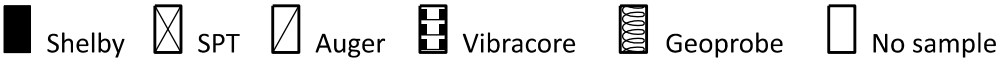
APPENDIX II

EUSTIS ENGINEERING SINCE 1946

LEGEND AND NOTES FOR LOG OF BORING AND TEST RESULTS

PP Pocket penetrometer: Resistance in tons per square foot

SPT Standard Penetration Test: Number of blows of a 140-lb hammer dropped 30 inches required to drive 2-in. O.D., 1.4-in. I.D. sampler a distance of 1 foot into the soil after first seating it 6 inches. Values shown have not been corrected.

SPLR Type of Sampling  Shelby, SPT, Auger, Vibracore, Geoprobe, No sample

SYMBOL Clay, Silt, Sand, Peat/Humus, Shells, Stone/Gravel

Predominant type shown heavy; modifying type shown light

USC Unified Soil Classification

DENSITY Unit weight in pounds per cubic foot

SHEAR TESTS

TYPE

- UC Unconfined compression shear
- OB Unconsolidated undrained triaxial compression shear on one specimen confined at the approximate overburden pressure
- UU Unconsolidated undrained triaxial compression shear
- ϕ Angle of internal friction in degrees
- c Cohesion in pounds per square foot

ATTERBERG LIMITS

- LL Liquid Limit
- PL Plastic Limit
- PI Plasticity Index

OTHER TESTS

- CON Consolidation
- -#200 Percent passing a U.S. No. 200 sieve
- SV Particle size distribution (sieve only)
- PD Particle size distribution (sieve and hydrometer)
- k Coefficient of permeability in centimeters per second
- SP Swelling pressure in pounds per square foot

Other laboratory test results reported on separate figures

GENERAL NOTES

(1) If a ground water depth is shown on the boring log, these observations were made at the time of drilling and were measured below the existing ground surface. These observations are shown on the boring logs. However, ground water levels may vary due to seasonal fluctuations and other factors. If important to construction, the depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

(2) While the individual logs of borings are considered to be representative of subsurface conditions at their respective locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

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Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-4

Project No: 24717.02
Date: 02/14/2024 - 02/15/2024
Latitude: 29.61052°
Longitude: -90.76376°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0	4.00				Moist, very stiff brown FAT CLAY w/trace of roots & concretions	CH	1	1											
	4.00						2	3	39	83	115	UC	--	2130					
5	1.50				Moist, stiff gray & tan FAT CLAY w/trace of silt pockets & concretions	CH	3	5											
	1.00						4	7	37	84	115	UC	--	1382					
	0.75				Moist, soft gray & tan FAT CLAY w/few silt pockets, concretions, & wood	CH	5	9	49	70	104	UC	--	339					
10	0.25				Moist, very soft gray FAT CLAY w/few roots	CH	6	11											
	0.25						7	14	83	52	95	OB	0	176					
15					Moist, very loose gray fine SILTY SAND	SM													
	0.00						8	19	32	90	119				NP	NP	NP		
20																			
		2					PB-9	24											
25																			
	0.25						10	29	31	91	119								
30					Moist, very soft gray FAT CLAY w/few sand pockets	CH													
	0.00						11	34											
35					Moist, soft gray FAT CLAY w/trace of silt pockets	CH													
	0.25						12	39	56	67	104	UC	--	406					
40																			
	0.25						13	44											
45					Moist, medium stiff dark gray ORGANIC CLAY	OH													
	0.50						14	49	85	49	91	UC	--	798					
50																			

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NOTES:

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Exploration and Design
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LOG OF BORING AND TEST RESULTS

Boring: B-4

Project No: 24717.02
Date: 02/14/2024 - 02/15/2024
Latitude: 29.61052°
Longitude: -90.76376°
Water Depth: See Text
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Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, medium stiff gray & brown ORGANIC CLAY w/few shells & wood	OH													
	0.75						15	54											
55					Moist, very loose gray CLAYEY SILT	ML													
		4					PB-16	58.5											
60					Moist, medium stiff gray FAT CLAY	CH													
	0.50						17	64	33	90	119	UC	--	668					
65																			
	0.50						18	69											
70					Moist, soft gray FAT CLAY	CH													
	0.50						19	74	60	64	103	UC	--	255					
75																			
	0.50				w/few shell fragments		20	79	61	63	102	UC	--	406					
80																			
	0.50						21	84	68	59	100	OB	0	307					
85					Moist, medium stiff gray & brown FAT CLAY w/trace of silt pockets & lenses	CH													
	0.75						22	89	58	66	104	UC	--	968					
90					Moist, soft gray FAT CLAY w/trace of silt pockets & lenses	CH													
	0.50						23	94	48	74	109	UC	--	298					
95																			
100	0.75						24	99	51	70	106	UC	--	305					

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NOTES:

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Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-4

Project No: 24717.02
Date: 02/14/2024 - 02/15/2024
Latitude: 29.61052°
Longitude: -90.76376°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
100					Moist, medium stiff gray FAT CLAY w/trace of silt pockets & lenses	CH													
105	0.75						25	104	51	68	103	UC	--	774					
110	1.00				Moist, very soft gray FAT CLAY w/trace of silt pockets	CH	26	109	55	64	100	UC	--	510					
115	0.25				Moist, stiff brown & gray ORGANIC CLAY	OH	27	114	61	64	103	OB	0	242	90	24	66		
120	0.50				Moist, stiff gray FAT CLAY w/trace of silt pockets & organic matter	CH	28	119	79	52	93	OB	0	1116					
125	1.25						29	124	35	85	114	OB	0	1703					
130	1.00				w/trace of silt pockets, organic matter, & concretions		30	129	46	75	110	OB	0	1851					
					Moist, loose tan POORLY GRADED SAND	SP													
135		12			Moist, medium dense tan fine POORLY GRADED SAND w/trace of silt	SP	31	134	19										-#200 = 3.6%
		17					PB-32	135.5											
140		31			Moist, dense tan fine POORLY GRADED SAND w/trace of silt	SP	PB-33	138.5											
							PB-34	141.5											
145		36					PB-35	144.5											
150		40					PB-36	148.5											

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NOTES:

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Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
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LOG OF BORING AND TEST RESULTS

Boring: B-5

Project No: 24717.02
Date: 02/18/2024 - 02/19/2024
Latitude: 29.61023°
Longitude: -90.76448°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0	1.50				Moist, stiff brown & gray FAT CLAY w/few vegetation & roots	CH	1	1											
	1.00				Moist, stiff gray & tan FAT CLAY w/few silt pockets & concretions (flocculated)	CH	2	3	37	85	116	UC	--	1002					
5	0.50				Moist, medium stiff gray FAT CLAY w/few silt pockets & organic matter	CH	3	5											
	0.00						4	7	60	65	104	OB	0	650					
					Moist, very soft gray FAT CLAY w/few roots	CH	5	9											
10							6	11											
					Moist, very soft gray FAT CLAY w/trace of silt pockets	CH	7	14	66	61	101								
15					Wet, very loose gray fine SILTY SAND	SM													
	0.50						8	19	27	95	121								
20																			
	0.75						9	24	27										
25					Moist, soft gray & black SILT w/few wood & organic matter	ML													
	0.50						10	29											
30					Moist, medium stiff brown ORGANIC CLAY	OH													
	1.00						11	34	183	26	74	UC	--	734					
35					Moist, medium stiff gray FAT CLAY	CH													
	0.50						12	39											
40																			
	0.50						13	44	48	74	109	UC	--	541					
45					Wet, loose tan SHELLS	SI													
50							14	49											

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LOG OF BORING AND TEST RESULTS

Boring: B-5

Project No: 24717.02
Date: 02/18/2024 - 02/19/2024
Latitude: 29.61023°
Longitude: -90.76448°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, soft gray FAT CLAY w/pocket of shells	CH													
	0.50						15	54											
55																			
	0.00				w/few silt pockets & trace of shell fragments		16	59	51	70	106	OB	0	367					
60																			
	0.25						17	64											
65					Moist, medium stiff gray FAT CLAY w/trace of silt pockets	CH													
	0.25						18	69	46	75	110	UC	--	766					
70					Moist, soft gray & black FAT CLAY w/few shells	CH													
	0.50						19	74											
75					Moist, very soft gray FAT CLAY w/few shell fragments	CH													
	0.25						20	79	53										
80					Moist, medium stiff gray FAT CLAY	CH													
	0.75						21	84	56	64	100	UC	--	590					
85					Moist, stiff gray FAT CLAY	CH													
	0.50						22	89	55	68	105	OB	0	1243	91	23	68		CONS
90					Moist, soft gray FAT CLAY w/few decayed wood & silt layers	CH													
	0.50						23	94	49	73	109	OB	0	499					
95																			
	0.75				w/trace of silt pockets		24	99	55	69	106	UC	--	390					
100																			

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NOTES:

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Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-5

Project No: 24717.02
Date: 02/18/2024 - 02/19/2024
Latitude: 29.61023°
Longitude: -90.76448°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
100					Moist, medium stiff gray FAT CLAY w/few silt lenses	CH													
	0.75						25	104	56	67	105	UC	--	632					
105					Moist, soft gray FAT CLAY w/trace of silt pockets & concretions	CH													
	0.50						26	109	57	66	104	OB	0	289					
110					Moist, soft gray LEAN CLAY	CL													
	0.50						27	114	32	89	117	OB	0	485					
115					Moist, soft gray FAT CLAY w/few silt pockets, organic matter, & concretions	CH													
	0.50						28	119	58	64	102	OB	0	281					
120					Moist, medium stiff gray FAT CLAY w/trace of concretions, organic matter, silt pockets, & lenses	CH													
	0.50						29	124	53	68	104	OB	0	638					
125					Moist, soft gray FAT CLAY w/few silt pockets & layers	CH													
	0.50						30	129	54	68	105	OB	0	409					
130																			
	0.50				w/trace of silt pockets		31	134	60										-#200 = 99.6%
135		11			Moist, medium dense tan & gray fine SILTY SAND	SM	PB-32	135.5	23										-#200 = 35.1%
		13					PB-33	138.5											
140					Moist, very dense tan & gray fine SILTY SAND	SM													
		59					PB-34	141.5											
145		61					PB-35	144.5											
		56					PB-36	148.5											
150																			

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NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-6

Project No: 24717.02
Date: 02/27/2024 - 03/03/2024
Latitude: 29.61058°
Longitude: -90.76448°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Other Tests
0	1.00				Moist, medium stiff gray & brown FAT CLAY w/few roots, w/trace of organic matter	CH	1	1	56									
	1.00						2	3	39	69	96	UC	--	516	82	21	61	
5	1.00				w/few silt pockets, concretions, & decayed wood		3	5	44	76	110	OB	0	912	71	21	50	
	0.00				Moist, soft gray & tan FAT CLAY w/few silt pockets, trace of roots, & concretions	CH	4	7	67									
	0.00						5	9	71									
10	0.00						6	11	69									
	0.75				Moist, extremely soft gray FAT CLAY w/few wood, roots, concretions, & trace of organic matter	CH	7	14	85	51	94	OB	0	103				
15					Moist, very loose to loose gray fine SILTY SAND	SM												
							8	19	25									-#200 = 16.3%
20		6					PB-9	20.5	26									-#200 = 21.9%
		4					PB-10	23.5	24									
25		4					PB-11	26.5	24									
		WOH					PB-12	29.5	38									
30					Moist, soft gray FAT CLAY w/trace of concretions & silt pockets	CH												
	0.75						13	34	40									
35																		
	0.25						14	39	42	78	111	OB	0	327				
40					Moist, loose gray fine SANDY SILT w/few shell fragments	ML												
	0.50						15	44	27	96	122							
45					Moist, loose gray fine POORLY GRADED SAND W/GRAVEL (fine, shells)	SP												
50							PB-16	49	15									

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NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-6

Project No: 24717.02
Date: 02/27/2024 - 03/03/2024
Latitude: 29.61058°
Longitude: -90.76448°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					Moist, stiff gray FAT CLAY w/few silt pockets	CH													
	0.50						17	54	47										
55					Moist, soft gray FAT CLAY w/trace of decayed wood	CH													
	0.50						18	59	76	55	97	OB	0	384					
60																			
	0.50						19	64	70										
65																			
	0.50						20	69	57	66	104	UC	--	249					
70					Moist, medium stiff gray FAT CLAY	CH													
	0.75						21	74	55										
75																			
	0.75						22	79	60										
80					Moist, extremely soft gray FAT CLAY w/trace of silt pockets	CH													
	0.00						23	84	74	56	98	OB	0	72					
85					Moist, medium stiff gray FAT CLAY	CH													
	0.75						24	89	57										
90																			
	0.50				w/trace of silt lenses		25	94	53	69	106	UC	--	637					
95																			
100	1.00						26	99	49										

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NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
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LOG OF BORING AND TEST RESULTS

Boring: B-6

Project No: 24717.02
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100					Moist, medium stiff gray FAT CLAY	CH													
105	1.00				Moist, very soft gray FAT CLAY	CH	27	104	52	71	107	UC	--	562					
110		WOH			Moist, medium stiff gray FAT CLAY	CH	PB-28	109	60										
115	1.00				Moist, stiff dark gray ORGANIC CLAY w/few decayed wood	OH	29	114	54	66	102	UC	--	528					
120	1.25				Moist, soft gray LEAN CLAY W/SAND (fine)	CL	30	119	83	50	92	UC	--	1267					
125		7			Moist, loose gray SILT	ML	31 PB-32	124 125.5	32 26	89	118	UC	--	340					-#200 = 81.2%
130		6 8			Moist, medium stiff to stiff gray LEAN CLAY	CL	PB-33 PB-34	128.5 131.5	32 33										
135		10					PB-35	134.5	32										
140		21			Moist, very stiff gray FAT CLAY w/few fine sand	CH	PB-36	138.5	39										
145		42			Moist, dense gray fine POORLY GRADED SAND	SP	PB-37	143.5	22										
150		11			Moist, stiff gray fine SANDY LEAN CLAY	CL	PB-38	148.5	29										

EUSTIS_GINT_LIBRARY_3_22_2023.GLB EE STANDARD BORING LOG 24717.02.GPJ 4/25/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-7

Project No: 24717.02
Date: 02/21/2024 - 03/12/2024
Latitude: 29.61053°
Longitude: -90.76503°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					78' Wash without sampling														
55																			
60																			
65																			
70																			
75																			
80	0.75				Moist, soft to medium stiff gray FAT CLAY w/trace of silt pockets & lenses	CH	1	79	65	61	101	UC	--	798					
85	0.75						2	84	54	69	106	UC	--	420					
90	0.25				w/trace of silt pockets & concretions		3	89	54	68	105	OB	0	320					
95	0.75				w/few silt pockets		4	94	53	70	107	UC	--	680					
100	0.25				w/trace of silt pockets & organic		5	99	54	69	106	OB	0	381	94	23	71		CONS

EUSTIS_GINT_LIBRARY_3_22_2023.GLB EE STANDARD BORING LOG 24717.02.GPJ 4/25/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-7

Project No: 24717.02
Date: 02/21/2024 - 03/12/2024
Latitude: 29.61053°
Longitude: -90.76503°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Other Tests
100					matter	CH												
					Moist, soft to medium stiff gray FAT CLAY w/trace of silt pockets & lenses													
105	0.75				w/trace of silt pockets & lenses		6	104	65	61	101	OB	0	276				
110	0.75						7	109	55	68	105	OB	0	801				
115	0.50						8	114	59	65	104	OB	0	497				
120	0.25						9	119	60	64	103	OB	0	351				
125					w/trace of silt pockets & organic matter		10	124	56	67	105	OB	0	399				
					Moist, black ORGANIC CLAY	OH												
130		13			Moist, medium dense tan fine POORLY GRADED SAND w/trace of silt	SP	PB-11 PB-12	129 130	188 25									-#200 = 2.7%
135		12			Moist, medium dense tan fine SILTY SAND	SM	PB-13	133.5	22									
140		28			Moist, very dense tan fine SILTY SAND	SM	PB-14	138.5	30									-#200 = 19.5%
145		64					PB-15	143.5	26									
150		51					PB-16	148.5	22									

EUSTIS_GINT_LIBRARY_3_22_2023.GLB EE STANDARD BORING LOG 24717.02.GPJ 4/25/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-8

Project No: 24717.02
Date: 03/13/2024 - 03/14/2024
Latitude: 29.61091°
Longitude: -90.76463°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					78' Wash without sampling														
55																			
60																			
65																			
70																			
75																			
80	0.50				Moist, medium stiff to stiff gray FAT CLAY w/trace of silt pockets & lenses	CH	1	79	59	65	104	OB	0	811					
85	0.50						2	84	59	65	103	UC	--	1085					
90	0.50						3	89	61	63	102	OB	0	578					
95	0.50				w/trace of silt pockets & concretions		4	94	51	70	106	OB	0	967					
100	0.50						5	99	57	66	103	OB	0	833					

NOTES:

EUSTIS_GINT_LIBRARY_3_22_2023.GLB EE STANDARD BORING LOG 24717.02.GPJ 4/25/24

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-8

Project No: 24717.02
Date: 03/13/2024 - 03/14/2024
Latitude: 29.61091°
Longitude: -90.76463°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
100					Moist, medium stiff to stiff gray FAT CLAY w/trace of silt pockets & lenses	CH													
105	0.25						6	104	61	62	100	OB	0	369	82	22	60		
110	0.50						7	109	56	67	104	OB	0	1139					
115	0.75						8	114	51	70	106	OB	0	1534					
					WOOD w/trace of clay	WD													
120							9	119	215										
					Moist, stiff gray FAT CLAY w/trace of silt pockets, concretions, wood, & organic matter	CH													
125	1.25						10	124	44	75	108	UC	--	1133					
130							NS	129											
					Moist, medium dense gray fine SILTY SAND	SM													
135		16					PB-11	133.5	29										-#200 = 38.5%
140		23					PB-12	138.5	26										
					Moist, very dense gray fine POORLY GRADED SAND W/SILT	SP-SM													
145		60					PB-13	143.5	24										
150		60=8"					PB-14	148.5	23										-#200 = 11.1%

EUSTIS_GINT_LIBRARY_3_22_2023.GLB EE STANDARD BORING LOG 24717.02.GPJ 4/25/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-9

Project No: 24717.02
Date: 03/15/2024 - 03/16/2024
Latitude: 29.61083°
Longitude: -90.76500°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
50					78' Wash without sampling														
55																			
60																			
65																			
70																			
75																			
80	0.50				Moist, medium stiff gray FAT CLAY	CH	1	79	60	64	103	UC	--	815					
85	0.50						2	84	48	73	108	OB	0	922					
90	0.75						3	89	59	65	103	UC	--	798					
95	0.50				Moist, medium stiff to stiff gray FAT CLAY w/few silt lenses	CH	4	94	51	71	107	UC	--	1069					
100	0.50						5	99	55	69	106	OB	0	1244					

EUSTIS_GINT_LIBRARY_3_22_2023.GLB EE STANDARD BORING LOG 24717.02.GPJ 4/25/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

Terrebonne General Medical Center
Supplemental Surcharge
Exploration and Design
Proposed Health and Wellness Center
Houma, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-9

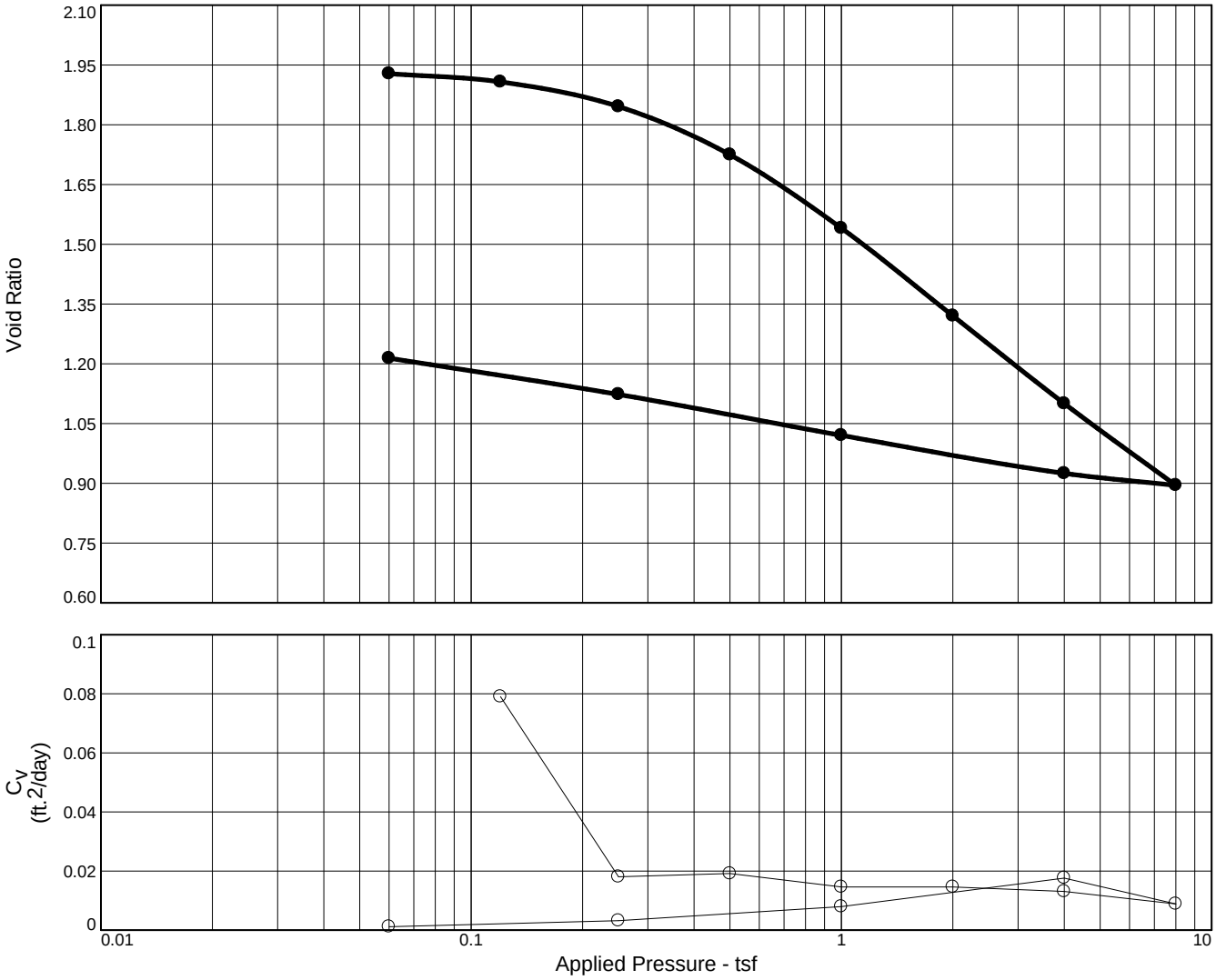
Project No: 24717.02
Date: 03/15/2024 - 03/16/2024
Latitude: 29.61083°
Longitude: -90.76500°
Water Depth: See Text
Total Depth: 150.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
100					Moist, medium stiff to stiff gray FAT CLAY w/few silt lenses	CH													
105	0.50						6	104	53	69	106	UC	--	1262					
110	0.50						7	109	65	61	101	OB	0	759					
115	1.00						8	114	51	71	107	UC	--	1068					
120	2.00				w/trace of decayed wood		9	119	69	59	99	OB	0	780					
125	0.50				w/trace of concretions		10	124	57	66	104	UC	--	334					
					Moist, soft gray FAT CLAY w/few fine sand pockets & lenses	CH													
130	0.50						11	129	71	58	99	OB	0	268					
					Moist, very stiff gray FAT CLAY w/few fine sand	CH													
135		30					PB-12	133.5	47										-#200 = 85.5%
					Moist, very dense gray fine SILTY SAND	SM													
140		72					PB-13	138.5	22										-#200 = 16.8%
145		66					PB-14	143.5	23										
150		64					PB-15	148.5	24										

EUSTIS_GINT_LIBRARY_3_22_2023.GLB EE STANDARD BORING LOG 24717.02.GPJ 4/25/24

NOTES:

CONSOLIDATION TEST REPORT



MATERIAL DESCRIPTION	USCS	AASHTO
M, vso g FT CL w/ tr si poc	CH	

LL	PI	Sp. Gr.	Overburden (tsf)	Dry Dens. (pcf)		Moisture		Saturation		Void Ratio		P_c (tsf)	C_c
				Init.	Final	Init.	Final	Init.	Final	Init.	Final		
90	66	2.72	--	57.9	76.7	70.2 %	50.3 %	98.8 %	100.0 %	1.933	1.214	0.6	0.75

Preparation Process: Trimmed in Ring

Condition of Test: Natural Moisture

D2435 Method	C_r	Swell Press. (tsf)	Swell %
B			

Project No. 24717.02 **Client:** ROZAS WARD ARCHITECTS, INC., NEW

Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND

Source of Sample: B-4 **Depth:** 114 **Sample Number:** 27

Remarks:

Checked By: BH

Title: Senior Lab Tech

EUSTIS ENGINEERING SINCE 1946

Figure

Tested By: BH

CONSOLIDATION TEST DATA

4/9/2024

Client: ROZAS WARD ARCHITECTS, INC., NEW ORLEANS, LOUISIANA
Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND WELLNESS CENTER, HOUMA (TERREBONNE PARISH), LOUISIANA
Project Number: 24717.02
Location: B-4
Depth: 114 **Sample Number:** 27
Material Description: M, vso g FT CL w/ tr si poc
Sample Date: 04/02/24 **Liquid Limit:** 90 **Plasticity Index:** 66
USCS: CH
Preparation Process: Trimmed in Ring
Condition of Test: Natural Moisture
Test Method: B **Final Density:** 76.7
Tested By: BH **Checked by:** BH **Title:** Senior Lab Tech

Test Specimen Data

NATURAL MOISTURE			VOID RATIO			AFTER TEST		
Wet w+t =	62.38	g.	Spec. Gr. =	2.72		Wet w+t =	86.43	g.
Dry w+t =	36.65	g.	Est. Ht. Solids =	0.263	in.	Dry w+t =	67.99	g.
Tare Wt. =	0.00	g.	Init. V.R. =	1.933		Tare Wt. =	31.34	g.
Moisture =	70.2	%	Init. Sat. =	98.8	%	Moisture =	50.3	%

UNIT WEIGHT			TEST START					
Height =	0.770	in.	Height =	0.770	in.	Dry Wt. =	36.65*	g.
Diameter =	1.997	in.	Diameter =	1.997	in.			
Weight =	62.38	g.						
Dry Dens. =	57.9	pcf						

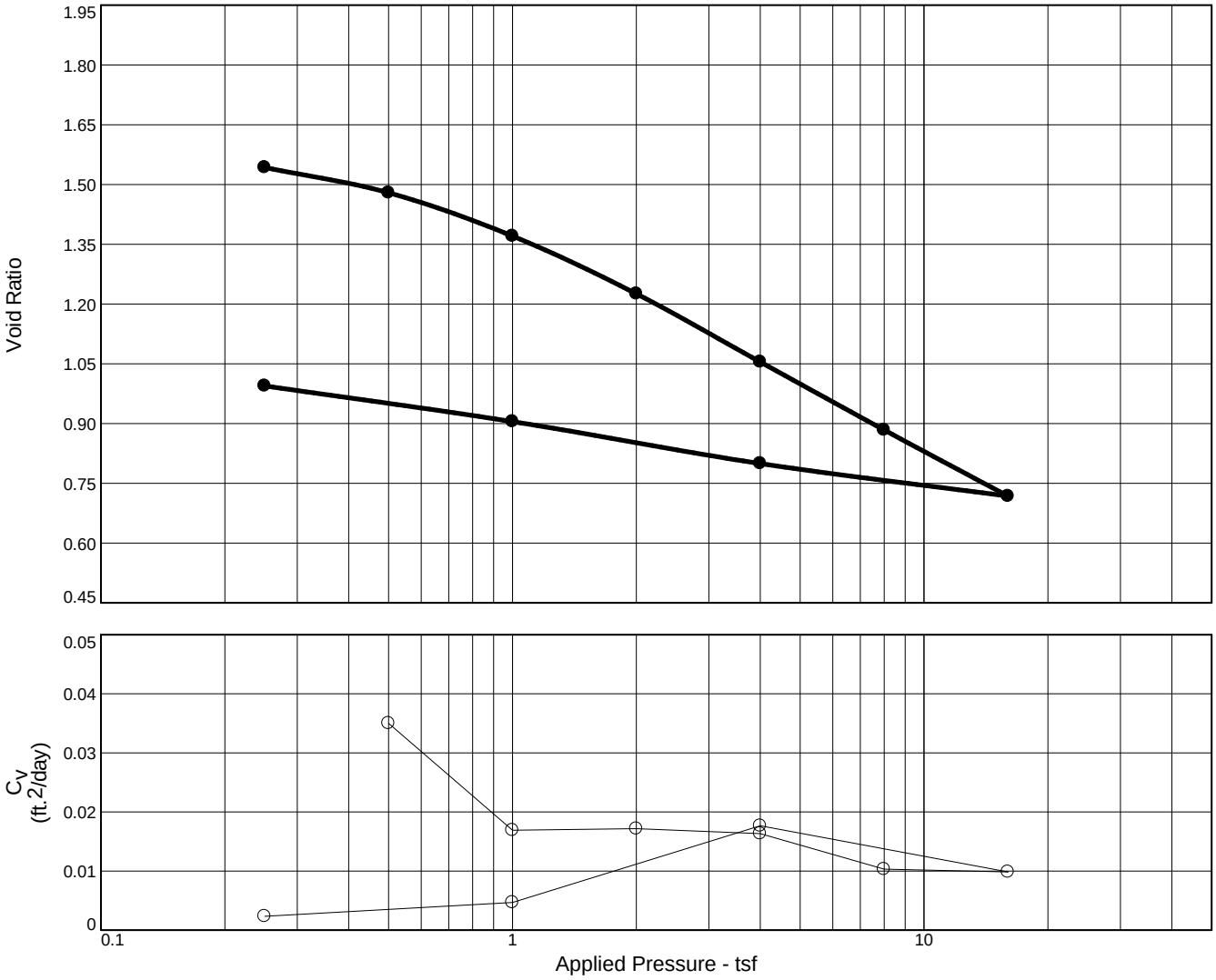
* Final dry weight used as mineral solids weight

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	0.73344	0.00000			1.933	
0.06	0.73473	0.00129		0.000	1.928	0.2 Comprs.
0.12	0.74018	0.00674	0.079	0.001	1.907	0.9 Comprs.
0.25	0.75638	0.02294	0.018	0.003	1.846	3.0 Comprs.
0.50	0.78815	0.05471	0.019	0.007	1.725	7.1 Comprs.
1.00	0.83655	0.10311	0.015	0.009	1.540	13.4 Comprs.
2.00	0.89430	0.16086	0.015	0.014	1.320	20.9 Comprs.
4.00	0.95210	0.21866	0.013	0.015	1.100	28.4 Comprs.
8.00	1.00597	0.27253	0.009	0.006	0.895	35.4 Comprs.
4.00	0.99808	0.26464	0.018	0.000	0.925	34.4 Comprs.
1.00	0.97306	0.23962	0.008		1.020	31.1 Comprs.
0.25	0.94610	0.21266	0.003		1.123	27.6 Comprs.
0.06	0.92217	0.18873	0.001		1.214	24.5 Comprs.

Compression index (C_c), tsf = 0.75 **Preconsolidation pressure (P_p), tsf =** 0.6 **Void ratio at P_p (e_m) =** 1.696
Overburden (σ_{vo}), tsf = --

CONSOLIDATION TEST REPORT



MATERIAL DESCRIPTION	USCS	AASHTO
M, st g FT CL	CH	

LL	PI	Sp. Gr.	Overburden (tsf)	Dry Dens. (pcf)		Moisture		Saturation		Void Ratio		P_c (tsf)	C_c
				Init.	Final	Init.	Final	Init.	Final	Init.	Final		
91	68	2.72	--	66.2	85.1	57.2 %	44.3 %	99.3 %	100.0 %	1.566	0.995	1.1	0.58

Preparation Process: Trimmed in Ring

Condition of Test: Natural Moisture

D2435 Method	C_r	Swell Press. (tsf)	Swell %
B			

Project No. 24717.02 **Client:** ROZAS WARD ARCHITECTS, INC., NEW

Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND

Source of Sample: B-5 **Depth:** 89 **Sample Number:** 22

Remarks:

Checked By: BH

Title: Senior Lab Tech

EUSTIS ENGINEERING SINCE 1946

Figure

Tested By: BH

CONSOLIDATION TEST DATA

4/9/2024

Client: ROZAS WARD ARCHITECTS, INC., NEW ORLEANS, LOUISIANA
Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND WELLNESS CENTER, HOUMA (TERREBONNE PARISH), LOUISIANA
Project Number: 24717.02
Location: B-5
Depth: 89 **Sample Number:** 22
Material Description: M, st g FT CL
Sample Date: 04/02/24 **Liquid Limit:** 91 **Plasticity Index:** 68
USCS: CH
Preparation Process: Trimmed in Ring
Condition of Test: Natural Moisture
Test Method: B **Final Density:** 85.1
Tested By: BH **Checked by:** BH **Title:** Senior Lab Tech

Test Specimen Data

NATURAL MOISTURE			VOID RATIO			AFTER TEST		
Wet w+t =	63.36	g.	Spec. Gr.	= 2.72		Wet w+t =	89.15	g.
Dry w+t =	40.31	g.	Est. Ht. Solids	= 0.289	in.	Dry w+t =	71.29	g.
Tare Wt. =	0.00	g.	Init. V.R.	= 1.566		Tare Wt. =	30.98	g.
Moisture =	57.2	%	Init. Sat.	= 99.3	%	Moisture =	44.3	%

UNIT WEIGHT			TEST START					
Height =	0.741	in.	Height	= 0.741	in.	Dry Wt. =	40.31*	g.
Diameter =	1.997	in.	Diameter	= 1.997	in.			
Weight =	63.36	g.						
Dry Dens. =	66.2	pcf						

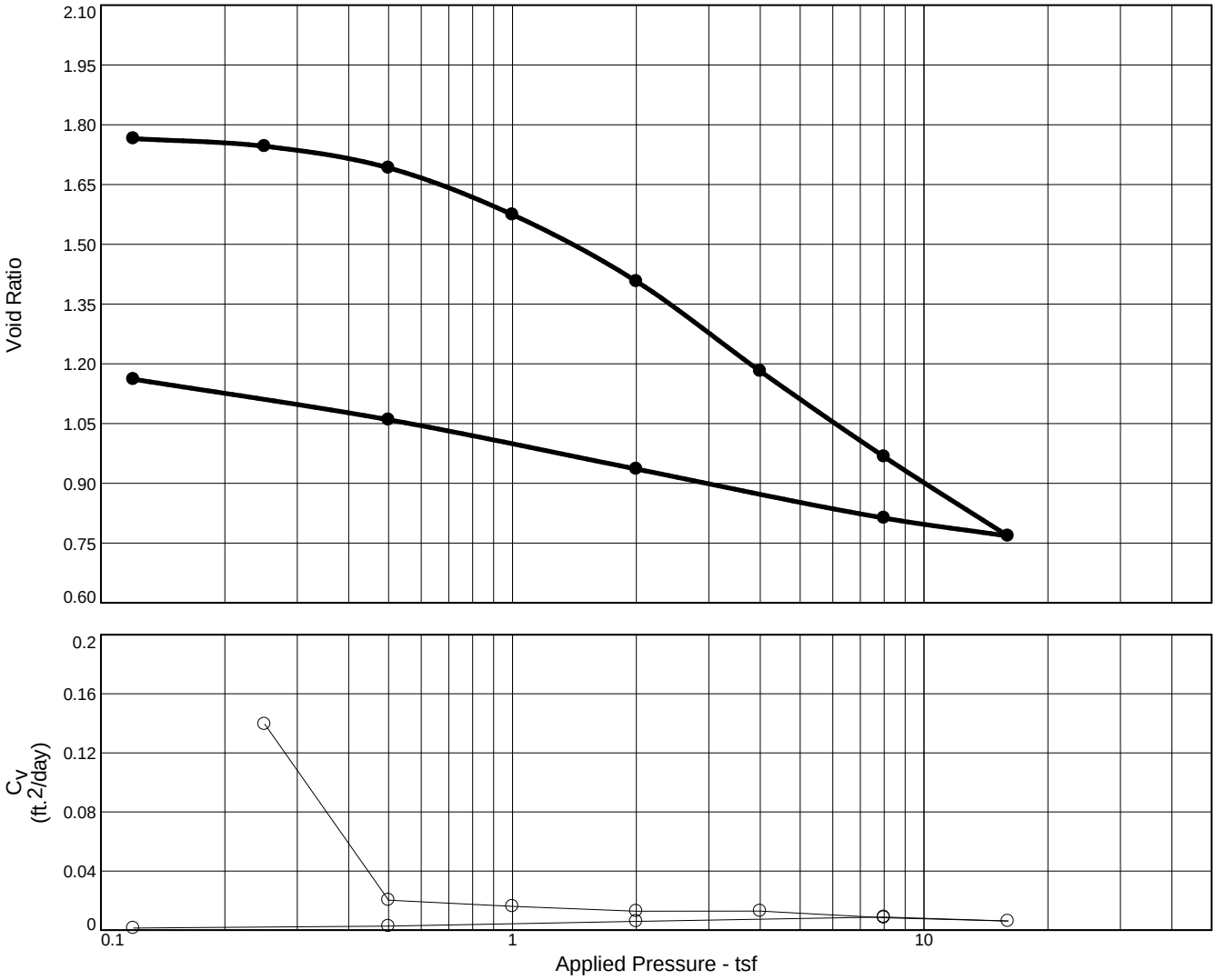
* Final dry weight used as mineral solids weight

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	0.86095	0.00000			1.566	
0.25	0.86779	0.00684		0.003	1.543	0.9 Comprs.
0.50	0.88611	0.02516	0.035	0.002	1.479	3.4 Comprs.
1.00	0.91746	0.05651	0.017	0.004	1.371	7.6 Comprs.
2.00	0.95933	0.09838	0.017	0.007	1.226	13.3 Comprs.
4.00	1.00872	0.14777	0.016	0.010	1.055	19.9 Comprs.
8.00	1.05798	0.19703	0.010	0.004	0.884	26.6 Comprs.
16.00	1.10592	0.24497	0.010	0.008	0.718	33.1 Comprs.
4.00	1.08232	0.22137	0.018		0.800	29.9 Comprs.
1.00	1.05193	0.19098	0.005		0.905	25.8 Comprs.
0.25	1.02607	0.16512	0.002		0.995	22.3 Comprs.

Compression index (C_c), tsf = 0.58 **Preconsolidation pressure (P_p), tsf =** 1.1 **Void ratio at P_p (e_m) =** 1.351
Overburden (σ_{vo}), tsf = --

CONSOLIDATION TEST REPORT



MATERIAL DESCRIPTION	USCS	AASHTO
M, so g FT CL w/ tr si poc & om	CH	

LL	PI	Sp. Gr.	Overburden (tsf)	Dry Dens. (pcf)		Moisture		Saturation		Void Ratio		P_c (tsf)	C_c
				Init.	Final	Init.	Final	Init.	Final	Init.	Final		
94	71	2.72	--	61.3	71.4	64.8 %	47.3 %	99.6 %	100.0 %	1.770	1.161	1.2	0.74

Preparation Process: Trimmed in Ring

Condition of Test: Natural Moisture

D2435 Method	C_r	Swell Press. (tsf)	Swell %
B			

Project No. 24717.02 **Client:** ROZAS WARD ARCHITECTS, INC., NEW

Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND

Source of Sample: B-7 **Depth:** 99 **Sample Number:** 5

Remarks:

Checked By: BH

Title: Senior Lab Tech

EUSTIS ENGINEERING SINCE 1946

Figure

Tested By: BH

CONSOLIDATION TEST DATA

4/9/2024

Client: ROZAS WARD ARCHITECTS, INC., NEW ORLEANS, LOUISIANA
Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND WELLNESS CENTER, HOUMA (TERREBONNE PARISH), LOUISIANA
Project Number: 24717.02
Location: B-7
Depth: 99 **Sample Number:** 5
Material Description: M, so g FT CL w/ tr si poc & om
Sample Date: 04/02/24 **Liquid Limit:** 94 **Plasticity Index:** 71
USCS: CH
Preparation Process: Trimmed in Ring
Condition of Test: Natural Moisture
Test Method: B **Final Density:** 71.4
Tested By: BH **Checked by:** BH **Title:** Senior Lab Tech

Test Specimen Data

NATURAL MOISTURE			VOID RATIO			AFTER TEST		
Wet w+t =	63.90	g.	Spec. Gr. =	2.72		Wet w+t =	87.18	g.
Dry w+t =	38.77	g.	Est. Ht. Solids =	0.278	in.	Dry w+t =	68.83	g.
Tare Wt. =	0.00	g.	Init. V.R. =	1.770		Tare Wt. =	30.06	g.
Moisture =	64.8	%	Init. Sat. =	99.6	%	Moisture =	47.3	%

UNIT WEIGHT			TEST START					
Height =	0.770	in.	Height =	0.770	in.	Dry Wt. =	38.77*	g.
Diameter =	1.996	in.	Diameter =	1.996	in.			
Weight =	63.90	g.						
Dry Dens. =	61.3	pcf						

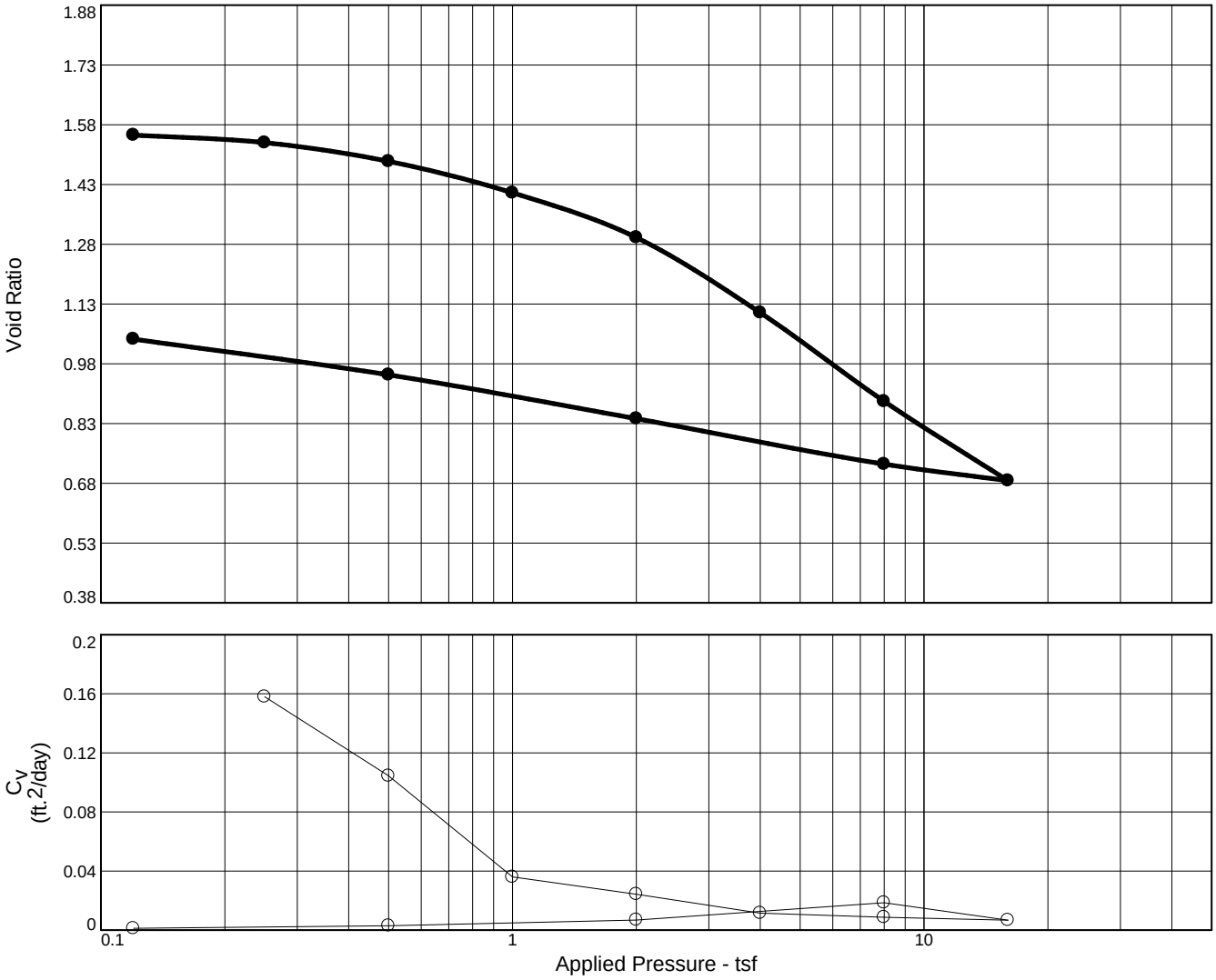
*** Final dry weight used as mineral solids weight**

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	0.46413	0.00000			1.770	
0.12	0.46545	0.00132		0.000	1.765	0.2 Comprs.
0.25	0.47082	0.00669	0.139	0.001	1.746	0.9 Comprs.
0.50	0.48587	0.02174	0.020	0.001	1.692	2.8 Comprs.
1.00	0.51856	0.05443	0.016	0.005	1.574	7.1 Comprs.
2.00	0.56500	0.10087	0.013	0.010	1.407	13.1 Comprs.
4.00	0.62770	0.16357	0.013	0.018	1.182	21.2 Comprs.
8.00	0.68741	0.22328	0.008	0.010	0.967	29.0 Comprs.
16.00	0.74273	0.27860	0.006	0.008	0.768	36.2 Comprs.
8.00	0.73019	0.26606	0.009	0.000	0.813	34.6 Comprs.
2.00	0.69598	0.23185	0.006		0.936	30.1 Comprs.
0.50	0.66160	0.19747	0.003		1.060	25.6 Comprs.
0.12	0.63335	0.16922	0.001		1.161	22.0 Comprs.

Compression index (C_c), tsf = 0.74 **Preconsolidation pressure (P_p), tsf =** 1.2 **Void ratio at P_p (e_m) =** 1.529
Overburden (σ_{vo}), tsf = --

CONSOLIDATION TEST REPORT



MATERIAL DESCRIPTION	USCS	AASHTO
M, so g FT CL	CH	

LL	PI	Sp. Gr.	Overburden (tsf)	Dry Dens. (pcf)		Moisture		Saturation		Void Ratio		P_c (tsf)	C_c
				Init.	Final	Init.	Final	Init.	Final	Init.	Final		
82	60	2.72	--	66.4	83.2	56.2 %	42.4 %	98.2 %	100.0 %	1.556	1.042	2.3	0.75

Preparation Process: Trimmed in Ring

Condition of Test: Natural Moisture

D2435 Method	C_r	Swell Press. (tsf)	Swell %
B			

Project No. 24717.02 **Client:** ROZAS WARD ARCHITECTS, INC., NEW

Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND

Source of Sample: B-8 **Depth:** 104 **Sample Number:** 6

Remarks:

Checked By: BH

Title: Senior Lab Tech

EUSTIS ENGINEERING SINCE 1946

Figure

Tested By: BH

CONSOLIDATION TEST DATA

4/25/2024

Client: ROZAS WARD ARCHITECTS, INC., NEW ORLEANS, LOUISIANA
Project: TERREBONNE GENERAL MEDICAL CENTER - SUPPLEMENTAL SURCHARGE EXPLORATION AND DESIGN, PROPOSED HEALTH AND WELLNESS CENTER, HOUMA (TERREBONNE PARISH), LOUISIANA
Project Number: 24717.02
Location: B-8
Depth: 104 **Sample Number:** 6
Material Description: M, so g FT CL
Sample Date: 04/02/24 **Liquid Limit:** 82 **Plasticity Index:** 60
USCS: CH
Preparation Process: Trimmed in Ring
Condition of Test: Natural Moisture
Test Method: B **Final Density:** 83.2
Tested By: BH **Checked by:** BH **Title:** Senior Lab Tech

Test Specimen Data

NATURAL MOISTURE			VOID RATIO			AFTER TEST		
Wet w+t =	66.04	g.	Spec. Gr. =	2.72		Wet w+t =	90.61	g.
Dry w+t =	42.29	g.	Est. Ht. Solids =	0.302	in.	Dry w+t =	72.69	g.
Tare Wt. =	0.00	g.	Init. V.R. =	1.556		Tare Wt. =	30.40	g.
Moisture =	56.2	%	Init. Sat. =	98.2	%	Moisture =	42.4	%

UNIT WEIGHT			TEST START					
Height =	0.772	in.	Height =	0.772	in.	Dry Wt. =	42.29*	g.
Diameter =	2.000	in.	Diameter =	2.000	in.			
Weight =	66.04	g.						
Dry Dens. =	66.4	pcf						

* **Final dry weight used as mineral solids weight**

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	0.31463	0.00000			1.556	
0.12	0.31530	0.00067		0.000	1.554	0.1 Comprs.
0.25	0.32103	0.00640	0.158	0.001	1.535	0.8 Comprs.
0.50	0.33522	0.02059	0.104	0.003	1.488	2.7 Comprs.
1.00	0.35907	0.04444	0.036	0.004	1.409	5.8 Comprs.
2.00	0.39291	0.07828	0.024	0.005	1.297	10.1 Comprs.
4.00	0.44992	0.13529	0.012	0.014	1.108	17.5 Comprs.
8.00	0.51708	0.20245	0.009	0.013	0.886	26.2 Comprs.
16.00	0.57725	0.26262	0.007	0.010	0.687	34.0 Comprs.
8.00	0.56469	0.25006	0.019		0.728	32.4 Comprs.
2.00	0.53025	0.21562	0.007		0.842	27.9 Comprs.
0.50	0.49703	0.18240	0.003		0.952	23.6 Comprs.
0.12	0.46996	0.15533	0.001		1.042	20.1 Comprs.

Compression index (C_c), tsf = 0.75 **Preconsolidation pressure (P_p), tsf =** 2.3 **Void ratio at P_p (e_m) =** 1.260
Overburden (σ_{vo}), tsf = --

DATE OF READING

2/12/25 3/4/25 3/24/25 4/13/25 5/3/25 5/23/25 6/12/25 7/2/25 7/22/25 8/11/25 8/31/25 9/20/25 10/10/25 10/30/25 11/19/25 12/9/25

SETTLEMENT IN INCHES

0 -4 -8 -12 -16 -20 -24

APPROXIMATE FILL HEIGHT ELEVATION IN FEET

20 15 10 5 0

NOTES:

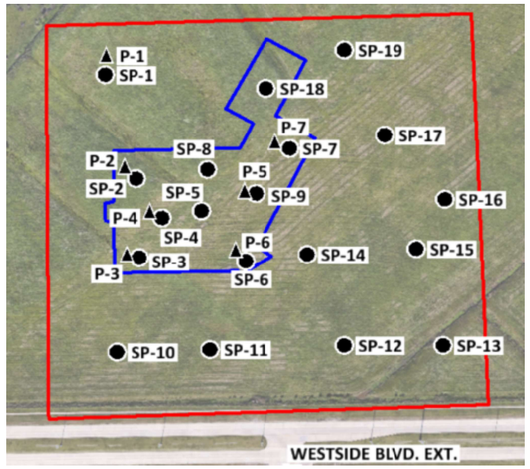
1. SETTLEMENT PLATE SP-1 WAS INSTALLED AND INITIALIZED ON 27 FEBRUARY 2025.

2. SETTLEMENT PLATES (SP-2 THROUGH SP-9 AND SP-18) WERE INSTALLED BETWEEN 20 MARCH AND 24 MARCH 2025. ALL PLATES WERE INITIALIZED BY 25 MARCH 2025.

3. APPROXIMATE FILL HEIGHT IS DETERMINED BY A GROUND SURFACE ELEVATION SHOT TAKEN NEAR SP-2 DURING OUR FIELD VISITS TIED TO PROJECT DATUM. FILL HEIGHT MONITORING WAS INITIALIZED ON 25 MARCH 2025.

LEGEND

SP-1	SP-7
SP-2	SP-8
SP-3	SP-9
SP-4	SP-18
SP-5	APPROXIMATE FILL HEIGHT NEAR SP-2
SP-6	



SUMMARY OF SETTLEMENT PLATE DATA
BUILDING FOOTPRINT
SP-1 THROUGH 9, SP-18

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE AND MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 28 JUL 2025
FILE NAME: SP - BUILDING	

DATE OF READING

2/12/25 3/4/25 3/24/25 4/13/25 5/3/25 5/23/25 6/12/25 7/2/25 7/22/25 8/11/25 8/31/25 9/20/25 10/10/25 10/30/25 11/19/25 12/9/25

SETTLEMENT IN INCHES

3 0 -3 -6 -9 -12 -15

APPROXIMATE FILL HEIGHT ELEVATION IN FEET

18 15 12 9 6 3 0

NOTES:

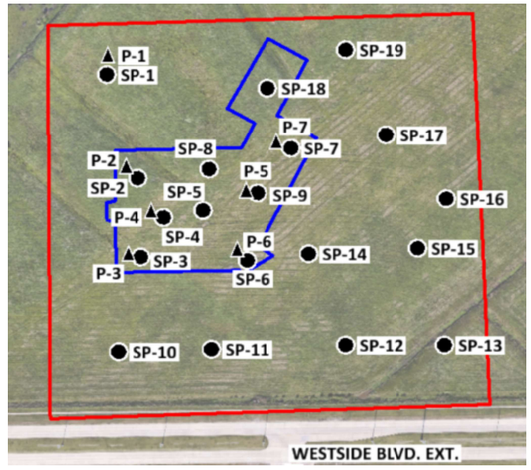
1. SETTLEMENT PLATES (SP-1, SP-10-SP-16) WERE INSTALLED AND INITIALIZED ON 27 FEBRUARY 2025. SETTLEMENT PLATES (SP-17 AND SP-19) WERE INSTALLED AND INITIALIZED ON 13 MARCH 2025.

2. APPROXIMATE FILL HEIGHT IS DETERMINED BY A GROUND SURFACE ELEVATION SHOT TAKEN NEAR SP-10 DURING OUR FIELD VISITS; TIED TO PROJECT DATUM. FILL HEIGHT MONITORING WAS INITIALIZED ON 25 MARCH 2025.

3. SETTLEMENT PLATE SP-17 WAS OBSERVED DAMAGED ON 22 MARCH 2025. THIS PLATE HAS BEEN REPLACED. SETTLEMENT PLATE SP-11 WAS OBSERVED DAMAGED ON 1 APRIL 2025. THIS PLATE HAS BEEN ABANDONED.

LEGEND

SP-1	SP-15
SP-10	SP-16
SP-11	SP-17
SP-12	SP-19
SP-13	APPROXIMATE FILL HEIGHT NEAR SP-10
SP-14	

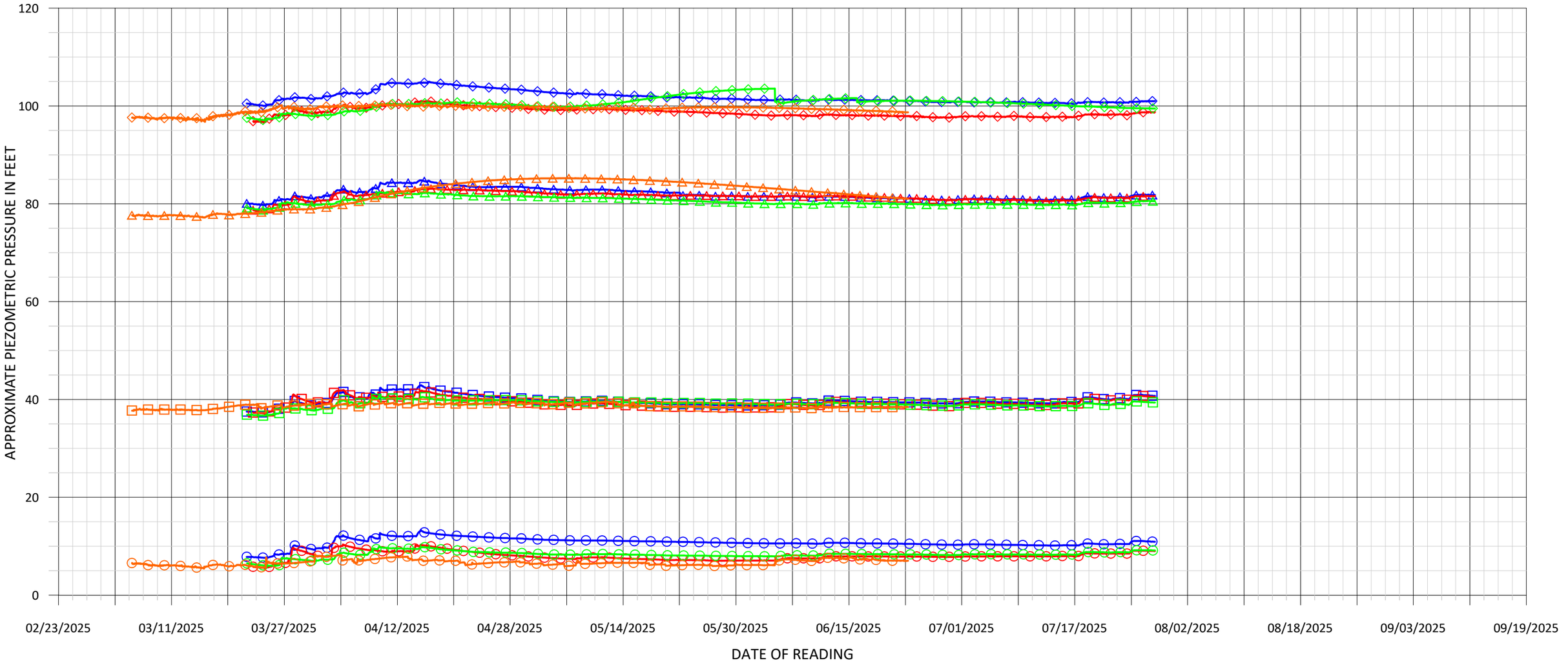


SUMMARY OF SETTLEMENT PLATE DATA
PARKING LOT FOOTPRINT
SP-1, SP-10 THROUGH SP-16, SP-17, SP-19

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE AND MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 28 JUL 2025
FILE NAME: SP - Parking Lot	



NOTES:

1. PIEZOMETERS AT LOCATION P-1 WERE INSTALLED ON 27 FEBRUARY 2025. PIEZOMETERS AT LOCATION P-2, P-3 AND P-4 WERE INSTALLED ON 17 THROUGH 19 MARCH 2025.

2. PIEZOMETERS AT P-1 WERE INITIALIZED ON 5 MARCH 2025. PIEZOMETERS AT P-2, P-3 AND P-4 WERE INITIALIZED ON 21 THROUGH 22 MARCH 2025.

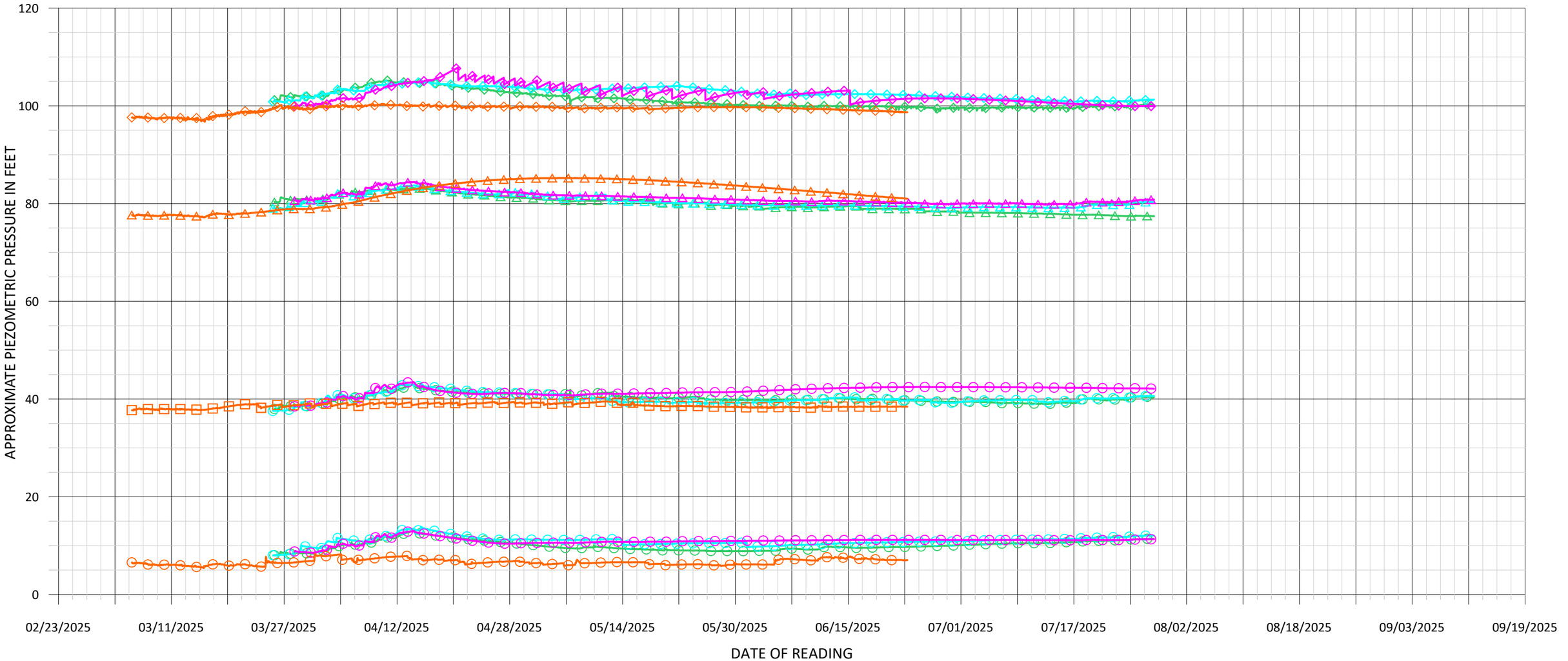
3. PIEZOMETERS AT P-1 - P-4 WERE INSTALLED AT DEPTHS 10', 40', 80', AND 100' BELOW EXISITING GRADE.

SUMMARY OF PIEZOMETER DATA
P-1, P-2, P-3, P-4

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.E.R	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 28 JUL 2025
FILE NAME: 24717.03 VWPs P-1	



NOTES:

1. PIEZOMETERS AT LOCATION P-1 WERE INSTALLED ON 27 FEBRUARY 2025. PIEZOMETERS AT LOCATION P-5, P-6 AND P-7 WERE INSTALLED ON 22 THROUGH 25 MARCH 2025.
2. PIEZOMETERS AT P-1 WERE INITIALIZED ON 5 MARCH 2025. PIEZOMETERS AT P-5, P-6 AND P-7 WERE INITIALIZED ON 25 THROUGH 28 MARCH 2025.
3. PIEZOMETERS AT P-1, 5-7 WERE INSTALLED AT DEPTHS 10', 40', 80', AND 100' BELOW EXISITING GRADE.

LEGEND

P-1 P-6

P-5 P-7

LEGEND

10' Depth 80' Depth

40' Depth 100' Depth

SUMMARY OF PIEZOMETER DATA
P-1, P-5, P-6, P-7

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 28 JUL 2025
FILE NAME: 24717.03 VWPs P-1	

DATE OF READING

2/12/25 3/4/25 3/24/25 4/13/25 5/3/25 5/23/25 6/12/25 7/2/25 7/22/25 8/11/25 8/31/25 9/20/25 10/10/25 10/30/25 11/19/25 12/9/25

SETTLEMENT IN INCHES

0 -5 -10 -15 -20 -25 -30

APPROXIMATE FILL HEIGHT IN FEET

15 10 5 0

NOTES:

1. SETTLEMENT PLATE SP-1 WAS INSTALLED AND INITIALIZED ON 27 FEBRUARY 2025.

2. SETTLEMENT PLATES (SP-2 THROUGH SP-9 AND SP-18) WERE INSTALLED BETWEEN 20 MARCH AND 24 MARCH 2025. ALL PLATES WERE INITIALIZED BY 25 MARCH 2025.

3. APPROXIMATE FILL HEIGHT IS DETERMINED BY A GROUND SURFACE ELEVATION SHOT TAKEN NEAR SP-2 DURING OUR FIELD VISITS TIED TO PROJECT DATUM. FILL HEIGHT MONITORING WAS INITIALIZED ON 25 MARCH 2025.

LEGEND

SP-1	SP-7
SP-2	SP-8
SP-3	SP-9
SP-4	SP-18
SP-5	APPROXIMATE FILL HEIGHT NEAR SP-2
SP-6	

SUMMARY OF SETTLEMENT PLATE DATA
BUILDING FOOTPRINT
SP-1 THROUGH 9, SP-18

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE AND MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: D.H.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 16 OCT 2025
FILE NAME: SP - BUILDING	

DATE OF READING

2/12/25 3/4/25 3/24/25 4/13/25 5/3/25 5/23/25 6/12/25 7/2/25 7/22/25 8/11/25 8/31/25 9/20/25 10/10/25 10/30/25 11/19/25 12/9/25

SETTLEMENT IN INCHES

3 0 -3 -6 -9 -12 -15

APPROXIMATE FILL HEIGHT ELEVATION IN FEET

18 15 12 9 6 3 0

NOTES:

1. SETTLEMENT PLATES (SP-1, SP-10-SP-16) WERE INSTALLED AND INITIALIZED ON 27 FEBRUARY 2025. SETTLEMENT PLATES (SP-17 AND SP-19) WERE INSTALLED AND INITIALIZED ON 13 MARCH 2025.

2. APPROXIMATE FILL HEIGHT IS DETERMINED BY A GROUND SURFACE ELEVATION SHOT TAKEN NEAR SP-10 DURING OUR FIELD VISITS; TIED TO PROJECT DATUM. FILL HEIGHT MONITORING WAS INITIALIZED ON 25 MARCH 2025.

3. SETTLEMENT PLATE SP-17 WAS OBSERVED DAMAGED ON 22 MARCH 2025. THIS PLATE HAS BEEN REPLACED. SETTLEMENT PLATE SP-11 WAS OBSERVED DAMAGED ON 1 APRIL 2025. THIS PLATE HAS BEEN ABANDONED.

LEGEND

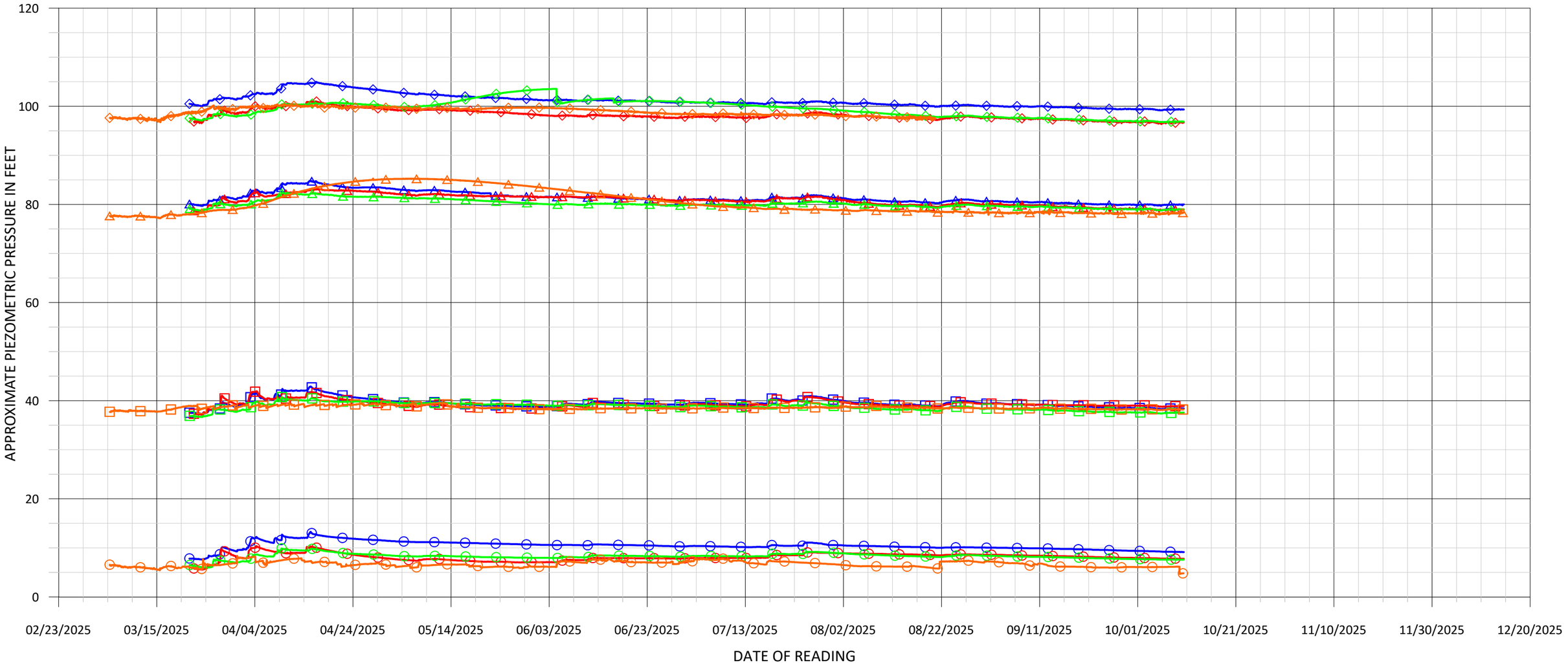
SP-1	SP-15
SP-10	SP-16
SP-11	SP-17
SP-12	SP-19
SP-13	APPROXIMATE FILL HEIGHT NEAR SP-10
SP-14	

SUMMARY OF SETTLEMENT PLATE DATA
PARKING LOT FOOTPRINT
SP-1, SP-10 THROUGH SP-16, SP-17, SP-19

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE AND MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: D.H.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 16 OCT 2025
FILE NAME: SP - Parking Lot	



NOTES:

1. PIEZOMETERS AT LOCATION P-1 WERE INSTALLED ON 27 FEBRUARY 2025. PIEZOMETERS AT LOCATION P-2, P-3 AND P-4 WERE INSTALLED ON 17 THROUGH 19 MARCH 2025.

2. PIEZOMETERS AT P-1 WERE INITIALIZED ON 5 MARCH 2025. PIEZOMETERS AT P-2, P-3 AND P-4 WERE INITIALIZED ON 21 THROUGH 22 MARCH 2025.

3. PIEZOMETERS AT P-1 - P-4 WERE INSTALLED AT DEPTHS 10', 40', 80', AND 100' BELOW EXISITING GRADE.

LEGEND

P-1 P-3

P-2 P-4

LEGEND

10' Depth 80' Depth

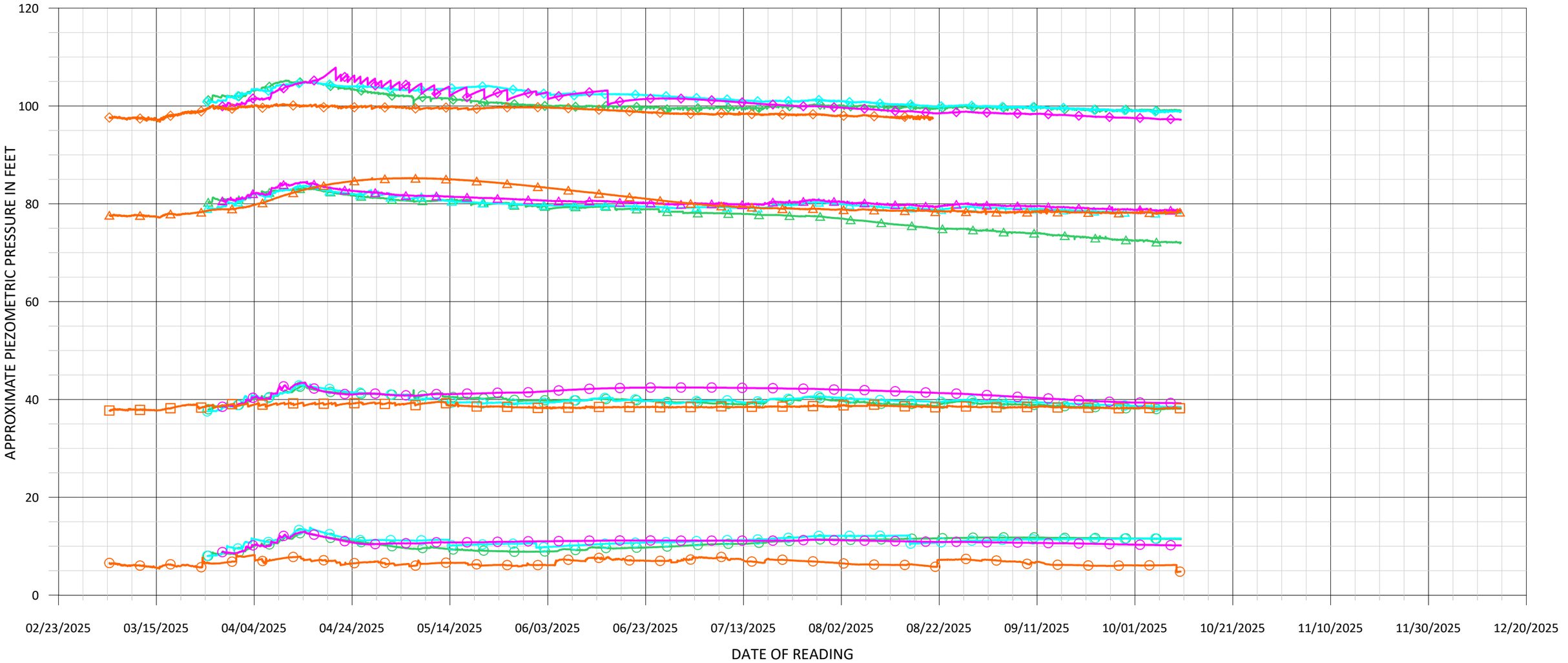
40' Depth 100' Depth

SUMMARY OF PIEZOMETER DATA
P-1, P-2, P-3, P-4

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: M.J.B.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 13 OCT 2025
FILE NAME: 24717.03 VWPs P-1	



NOTES:

1. PIEZOMETERS AT LOCATION P-1 WERE INSTALLED ON 27 FEBRUARY 2025. PIEZOMETERS AT LOCATION P-5, P-6 AND P-7 WERE INSTALLED ON 22 THROUGH 25 MARCH 2025.

2. PIEZOMETERS AT P-1 WERE INITIALIZED ON 5 MARCH 2025. PIEZOMETERS AT P-5, P-6 AND P-7 WERE INITIALIZED ON 25 THROUGH 28 MARCH 2025.

3. PIEZOMETERS AT P-1, 5-7 WERE INSTALLED AT DEPTHS 10', 40', 80', AND 100' BELOW EXISITING GRADE.

LEGEND

P-1 — P-6

P-5 — P-7

LEGEND

○ 10' Depth △ 80' Depth

□ 40' Depth ◇ 100' Depth

SUMMARY OF PIEZOMETER DATA
P-1, P-5, P-6, P-7

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: M.J.B.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 13 OCT 2025
FILE NAME: 24717.03 VWPs P-1	

7 May 2025

Terrebonne General Medical Center
8166 West Main Street
Houma, Louisiana 70360

Attention Mr. Kevin Ghirardi
PN 1-985-873-4604
Email kevin.ghirardi@tghealthsystem.com

Ladies and Gentlemen:

Geotechnical Exploration
Instrumentation Installation Report
Terrebonne General Medical Center
Surcharge Monitoring Program
Proposed Health and Wellness Center
Houma, Louisiana
Eustis Engineering Project No. 24717.03

Eustis Engineering L.L.C. has prepared this letter report to document the geotechnical instrumentation that has been installed to monitor the earthen surcharge/preload program being performed for the Terrebonne General Medical Center's (TGMC's) new Health and Wellness Center in Houma, Louisiana. This work was performed in general accordance with the scope of service outlined in Eustis Engineering's proposal, dated 2 August 2024.

Background

The project site includes an earthen surcharge program being performed for the proposed building along with a preload program for proposed parking areas. The construction areas were cleared, stripped, and leveled to near el 4 (NAVD 88) by Beverly Construction Company, L.L.C., (Beverly) prior to Eustis Engineering mobilizing to the project site. DGI-Menard Inc. (Menard) installed prefabricated vertical ("wick") drains and horizontal strip drains. Once installed, Beverly covered the wick and horizontal strip drains with approximately 6 inches of structural fill. Eustis Engineering mobilized to the site to begin our instrument installations on 27 February 2025 as Menard was nearing completion of their installations.

Scope of Service

Our scope of service includes installation and monitoring of seven vibrating wire piezometer "nests" to monitor pore pressures in the foundation soils below the proposed surcharges. A "nest" is a group of piezometers installed at one location with piezometers positioned at various depths within the subsurface. Additionally, our scope includes fabrication, installation, and monitoring of 19 settlement plates, designated as SP-1 through SP-19, with 5 to 10 feet of riser pipes extending above the surface. Finally, our scope of service includes providing one installation report and ongoing monitoring of the instrumentation.

Instrumentation Installation Procedures

Vibrating Wire Piezometers. Between 27 February and 25 March 2025, Eustis Engineering drilled seven 4-in. diameter boreholes at the TGMC project site. The boreholes were advanced to approximately 105 feet below the existing ground surface (B.E.G.S.). Piezometers were installed to approximate depths of 10', 40', 80', and 100' B.E.G.S. Approximate locations of each piezometer nest installation are shown on the Enclosure and are denoted as P-1 to P-7.

VIBRATING WIRE PIEZOMETERS DETAILS

INSTRUMENT IDENTIFICATION	TOTAL DEPTH DRILLED (B.E.G.S.) IN FEET
P-1	105
P-2	105
P-3	105
P-4	105
P-5	105
P-6	105
P-7	105

All piezometers were drilled using mud-rotary techniques with our track-mounted drill rig. Four piezometers were "nested" together within the boreholes affixed to a 0.75-in. PVC tremie grout pipe, per the manufacturer's recommendations. The piezometers were installed with the piezometer's screen/filter pointing upward at the appropriate depths. The piezometers and signal cables were secured to the PVC tremie pipe bound together with tape.

Prior to grouting the boreholes, a representative of Eustis Engineering measured the grout/mud weight of a Portland Cement Concrete (PCC) and bentonite gel mixture. The PCC and bentonite gel grout mix was then tremied into the boreholes through the PVC grout pipe before extracting the surface casing. The piezometers are permanently held into position by the PVC grout pipe which remains in place to ensure correct piezometer placement. Once the piezometers were grouted in place, the PVC grout pipe was cut at the anticipated ground surface. Refer to

Appendix I for the piezometer installation data sheets, Appendix II for information on grouting procedures, and Appendix III for calibration certificates for all piezometers.

During installation of the piezometer nests, drilling fluid circulation was lost in an apparent shell layer near the 50 to 55-ft. depth at the P-5 location. Three attempts at the originally proposed location were undertaken before moving the piezometer nest adjacent to SP-9 for successful installation.

Settlement Plates

Settlement plates are surficial monuments used to measure settlement over time at the project site. Approximate locations of each settlement plate are shown on the Enclosure and are denoted as SP-1 to SP-19. Eustis Engineering installed 19 settlement plates comprising a 2' x 2' x 0.25" steel plate with 2-in. couplings welded to the base of the plate, and 5-ft riser pipes attached to extend above the surface. On 27 February 2025, SP-1 and SP-10 through SP-16 were installed and initial elevations were recorded. On 13 March 2025, SP-17 and SP-19 were installed and initial elevations were recorded. Between 20 and 24 March 2025, SP-2 through SP-9 and SP-18 were installed and initial elevations were recorded on 25 March 2025.

The parking lot was constructed to el 6. SP-1, SP-10 through SP-17, and SP-19 were installed approximately 1-ft. B.E.G.S. within the parking lot surcharge area. This area is not receiving any additional fill placement, so only one 5-ft. riser pipe has been affixed to the steel plate. SP-2 through SP-9 and SP-18 are located within the building footprint surcharge area. This area is receiving fill placement, requiring two 5-ft. riser pipes affixed to the steel plates to extend above the ground surface. All riser pipes were marked at 1-ft. intervals to assist in observing the progress of fill placement.

On 22 March 2025, SP-17 was observed to be damaged by a likely vehicle impact and a replacement plate was installed on 24 March 2025. On 1 April 2025, SP-11 was also observed damaged and has been abandoned. Each settlement plate will be surveyed weekly by a representative of Eustis Engineering for up to one month after the completion of fill placement and bi-weekly until the end of the 6-month hold period. Refer to Appendix I for the settlement plate installation data sheets for additional information.

Data Loggers

The 4-channel V-Logger data loggers are supported on 2-in. riser pipes of the settlement plate adjacent to each piezometer nest. The signal cables of each piezometer nest are connected by the manufacturer's instructions and in sequence to each instrument nest. Data loggers will record readings on an hourly interval during surcharge monitoring. A representative of Eustis Engineering will manually download data from the data loggers once a week during monitoring and once every two weeks during the hold period. Refer to Appendix III for calibration certificates for all data loggers.

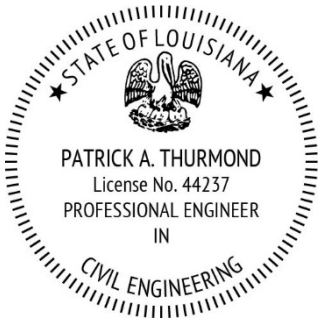
Closing

Thank you for asking us to perform these services. If you have any questions, please do not hesitate to contact us.

Yours very truly,

EUSTIS ENGINEERING L.L.C.

PATRICK A. THURMOND, P.E.

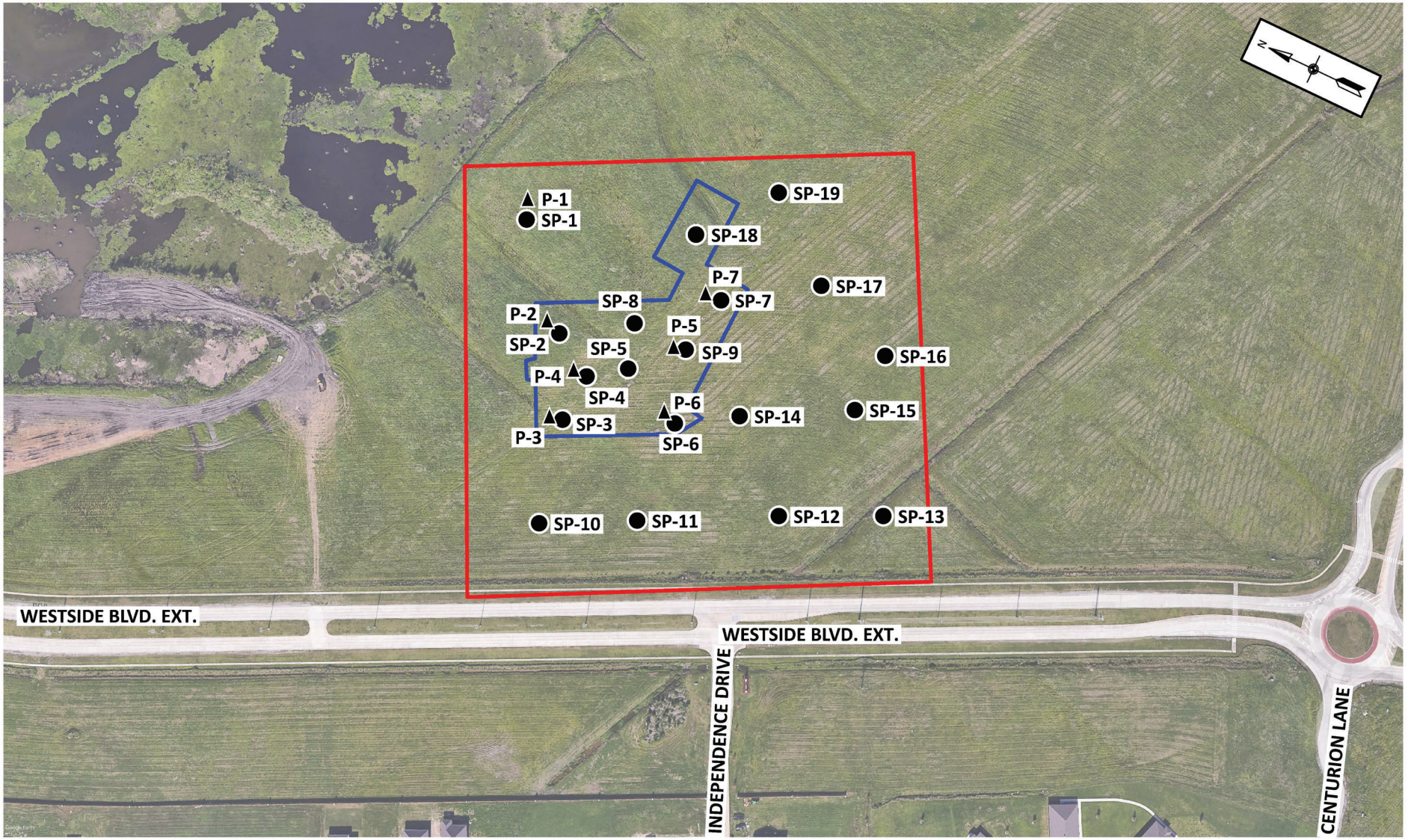


A.E. Russell:rmw/ssp

Enclosure
Appendices I through III

cc: Terrebonne General Medical Center
Mr. Mark Hebert
mark.hebert@tgmc.com

AQ Studios, LLC
Ms. Giulia Irwin
giulia@aqteam.com



SATELLITE IMAGERY DATED: 17 APRIL 2022

NOT TO SCALE

▲ DENOTES APPROXIMATE LOCATIONS OF PIEZOMETERS INSTALLED BETWEEN 27 FEBRUARY 2025 AND 25 MARCH 2025.

● DENOTES APPROXIMATE LOCATIONS OF SETTLEMENT PLATES INSTALLED BETWEEN 27 FEBRUARY 2025 AND 24 MARCH 2025.

DENOTES APPROXIMATE LOCATION OF THE PROPOSED BUILDING FOOTPRINT.

DENOTES APPROXIMATE LOCATION OF THE PROPOSED PAVEMENT AREA.

INSTRUMENTATION LOCATION PLAN

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: P.A.T.	DATE: 7 MAY 2025
CADD FILE: LOCATION PLAN.DGN	ENCLOSURE

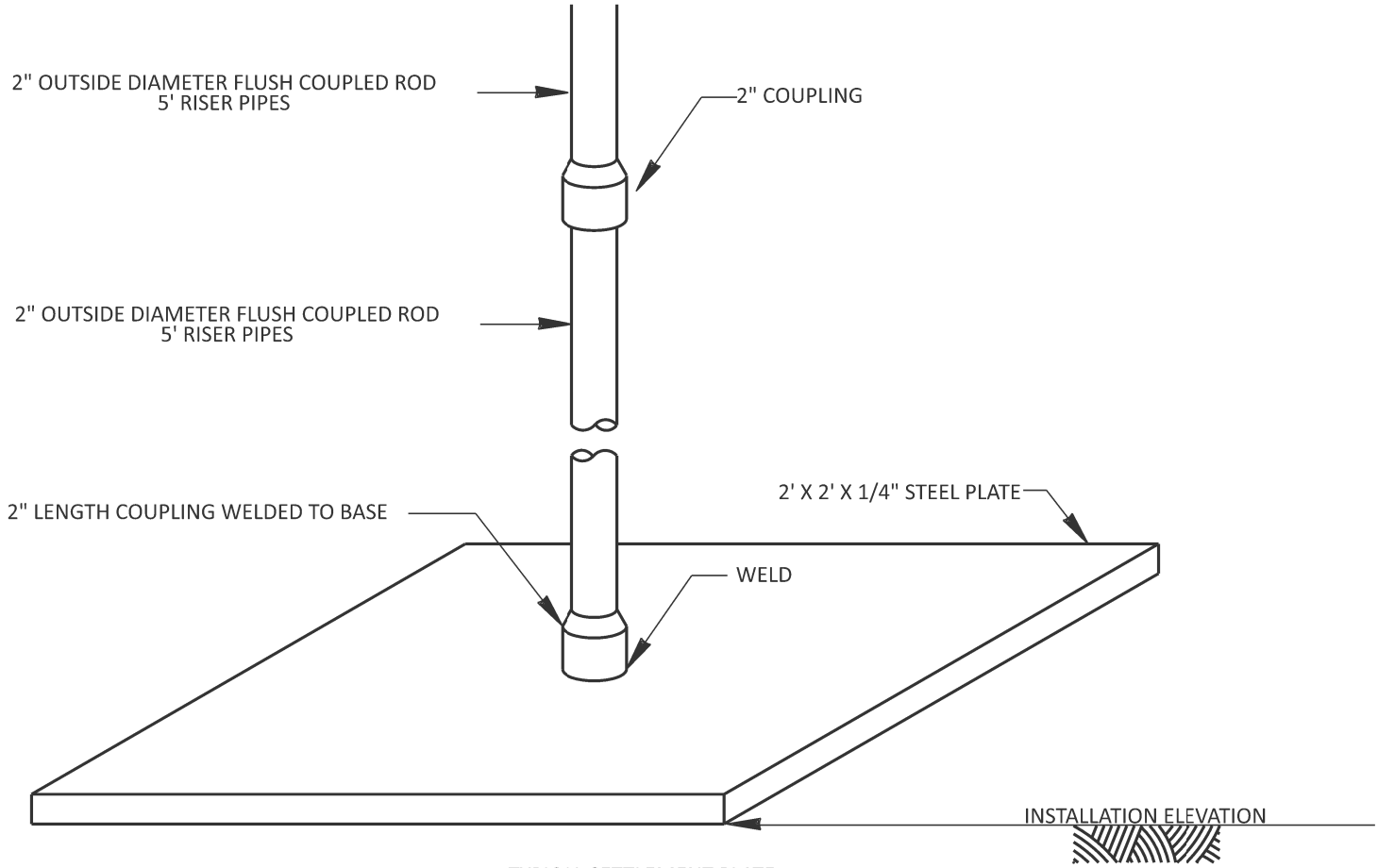
APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-1

G.P.S. COORDINATES 29.6113541, -90.7639391

INSTALLATION ELEVATION 2.53'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	63
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 27 FEBRUARY 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

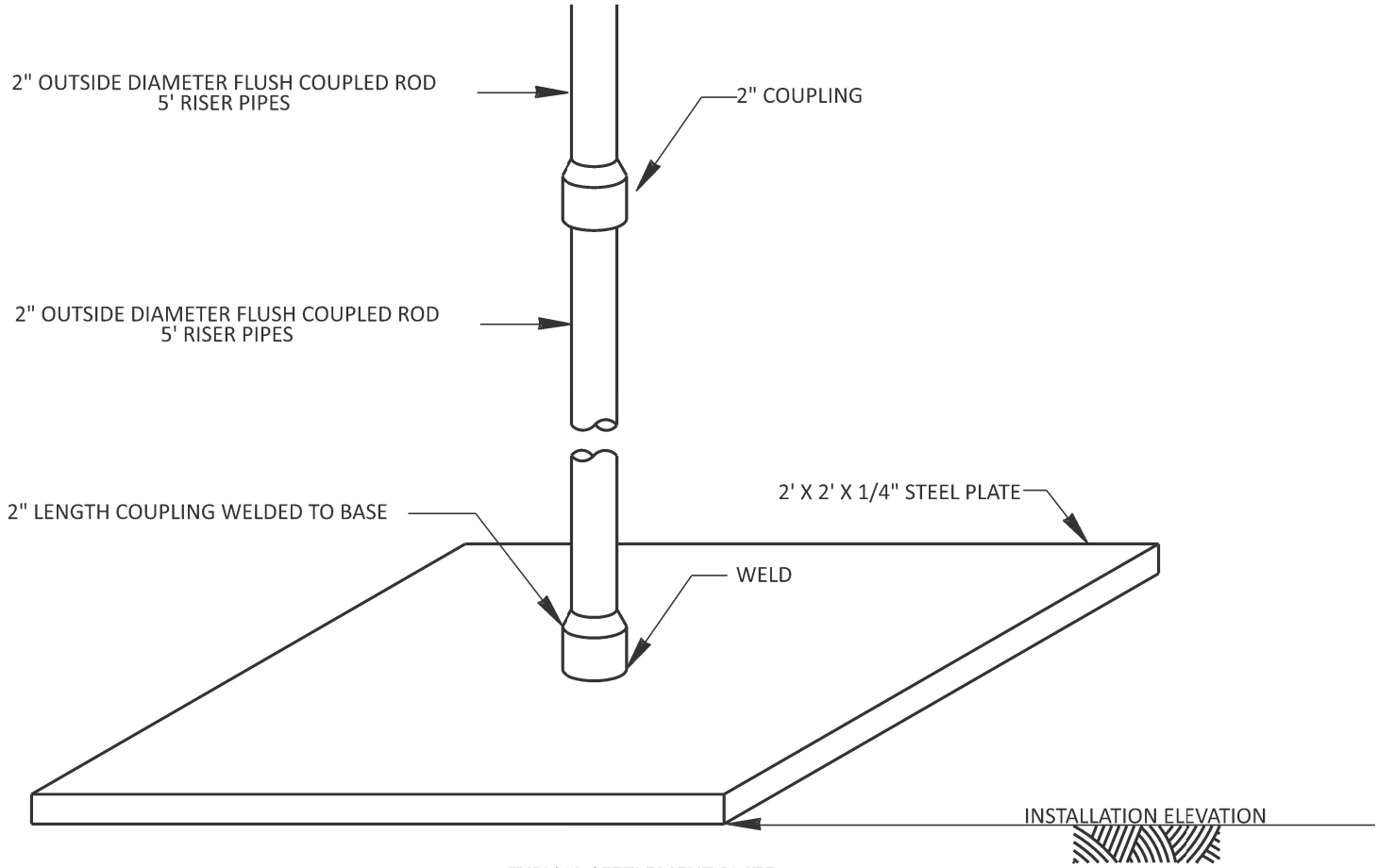
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-1.DGN	APPENDIX I

INSTALLATION DATE 20 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-2

G.P.S. COORDINATES 29.6111131, -90.7645784

INSTALLATION ELEVATION 5.77'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 3/4
2	59 1/4
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 21 MARCH 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

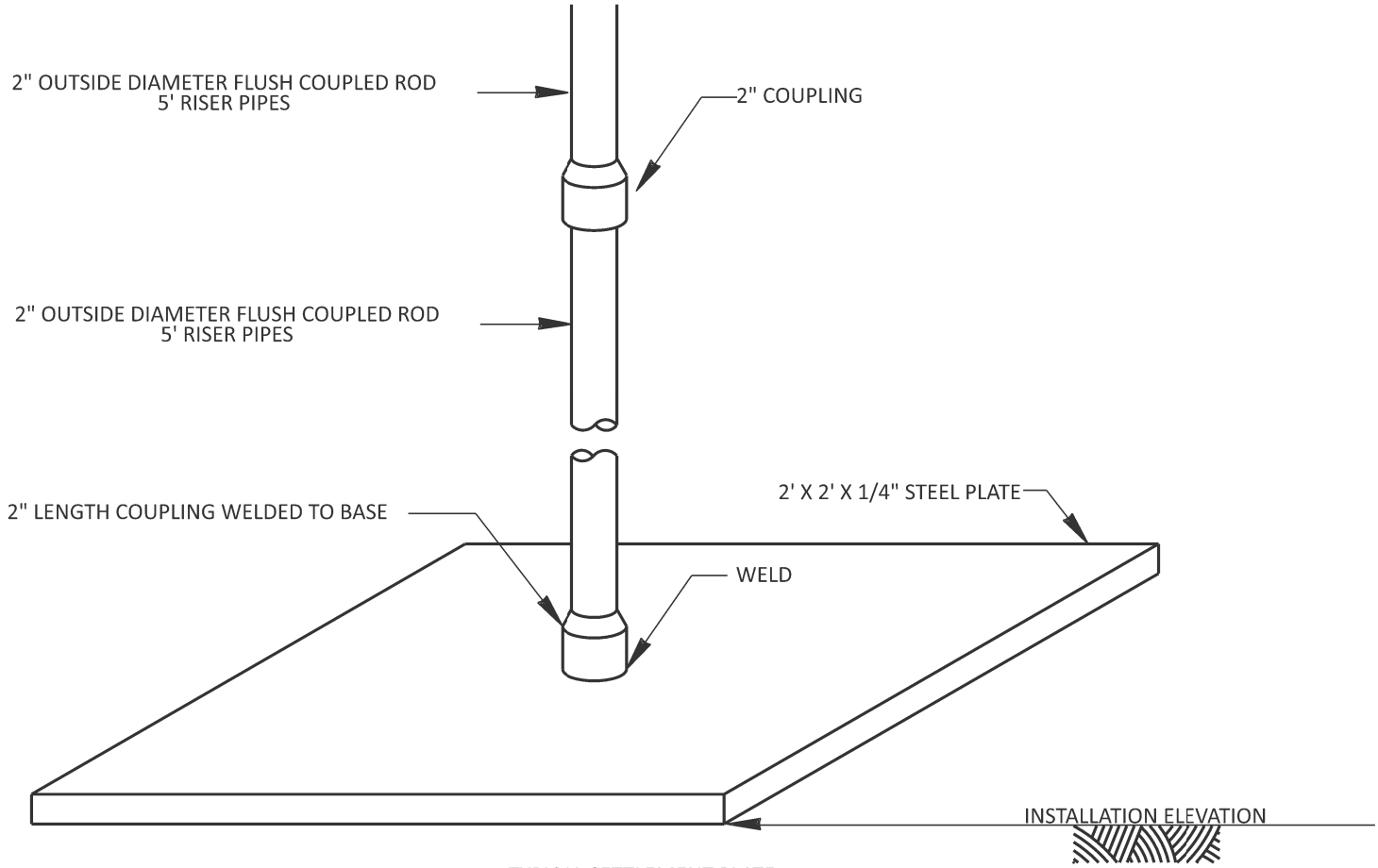
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-2.DGN	APPENDIX I

INSTALLATION DATE 20 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-3

G.P.S. COORDINATES 29.6109315, -90.7651863

INSTALLATION ELEVATION 5.80'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 7/8
2	59 1/4
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 21 MARCH 2025.
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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

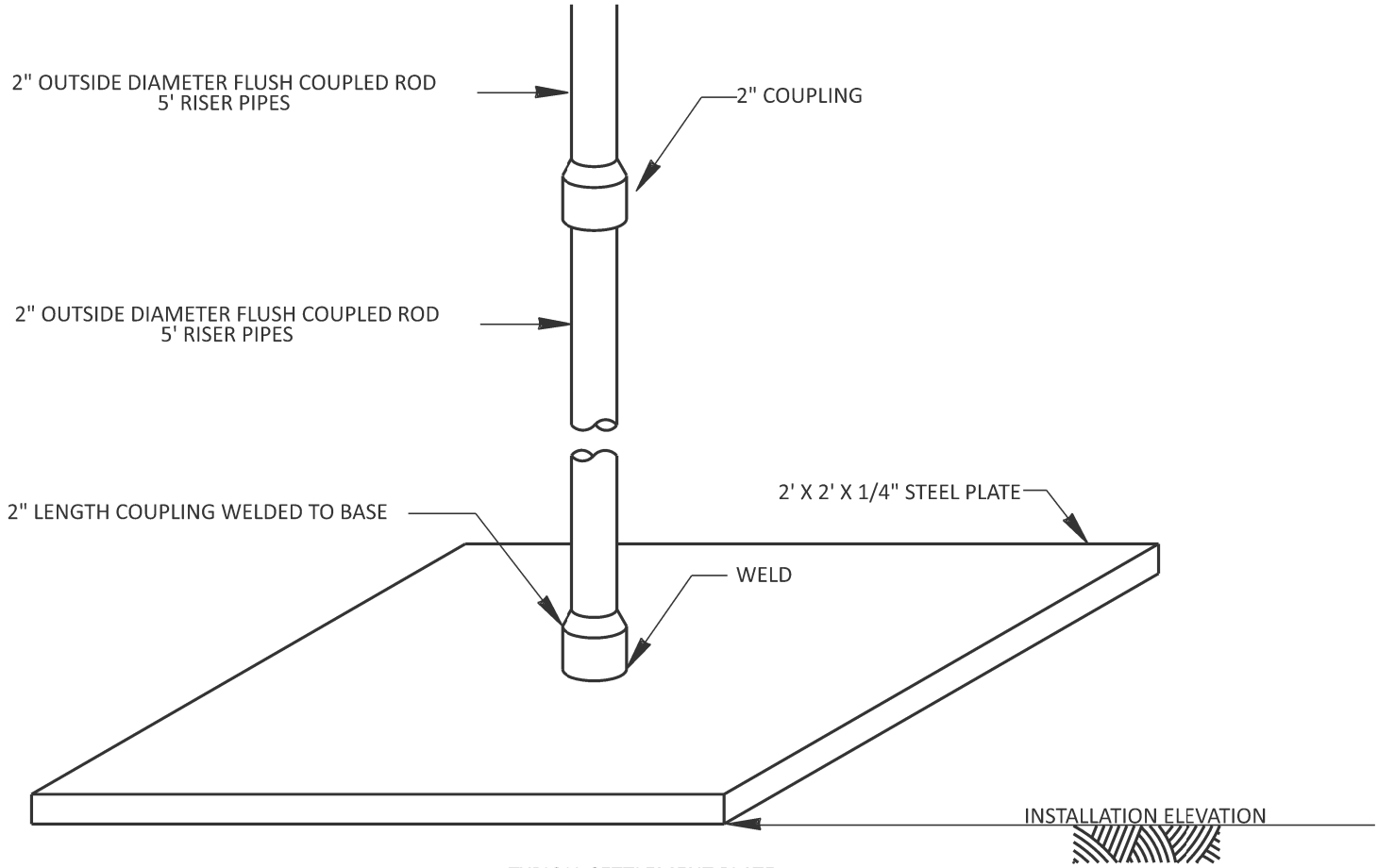
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-3.DGN	APPENDIX I

INSTALLATION DATE 20 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-4

G.P.S. COORDINATES 29.6108983, -90.7698383

INSTALLATION ELEVATION 5.74'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 5/8
2	59 3/8
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 21 MARCH 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

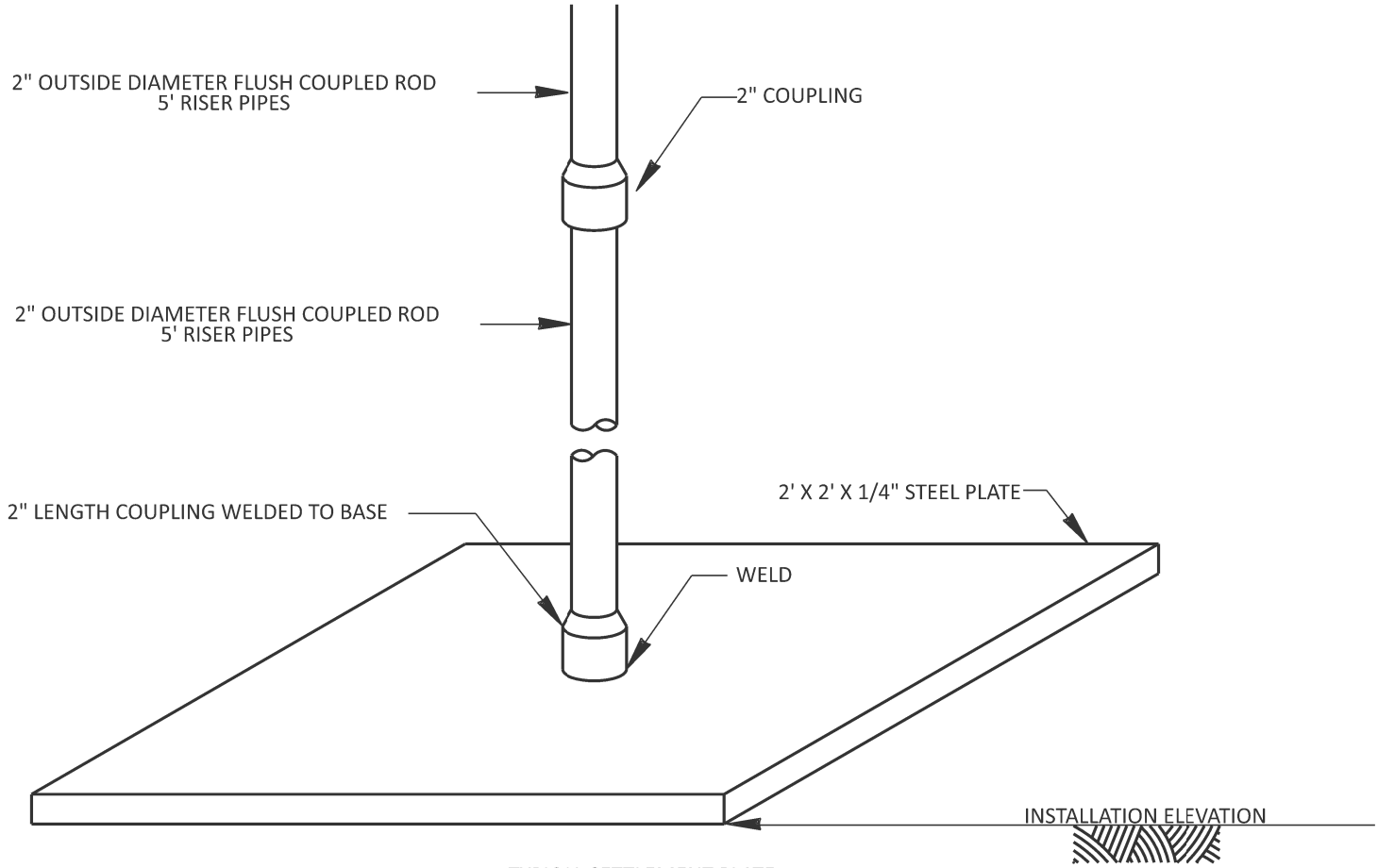
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-4.DGN	APPENDIX I

INSTALLATION DATE 24 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-5

G.P.S. COORDINATES 29.6105712, -90.7646944

INSTALLATION ELEVATION 5.79'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	63
2	59 3/8
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 25 MARCH 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION OF 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

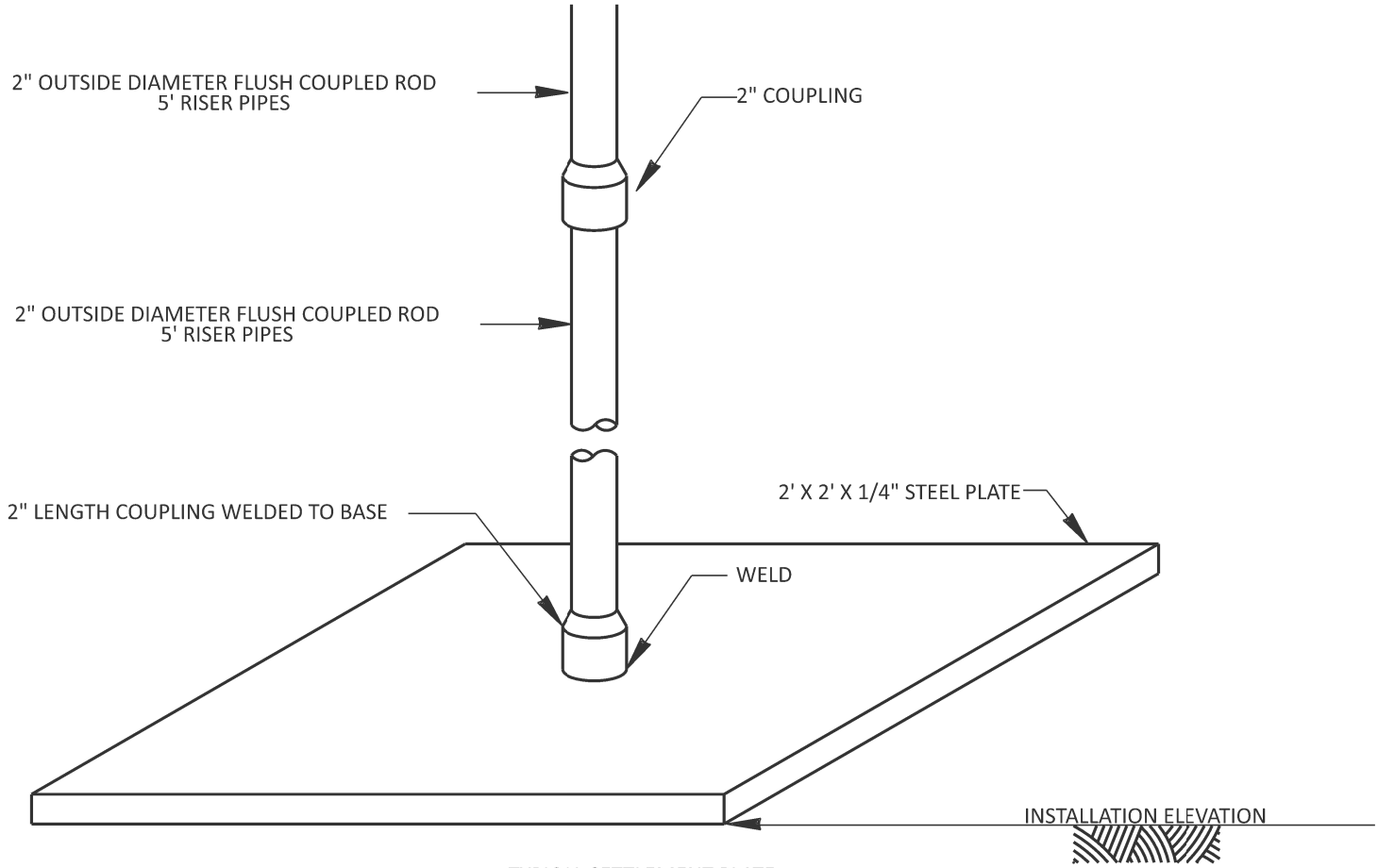
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-5.DGN	APPENDIX I

INSTALLATION DATE 22 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-6

G.P.S. COORDINATES 29.6103809, -90.7649402

INSTALLATION ELEVATION 5.44'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	63 1/4
2	59
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 25 MARCH 2025.
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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

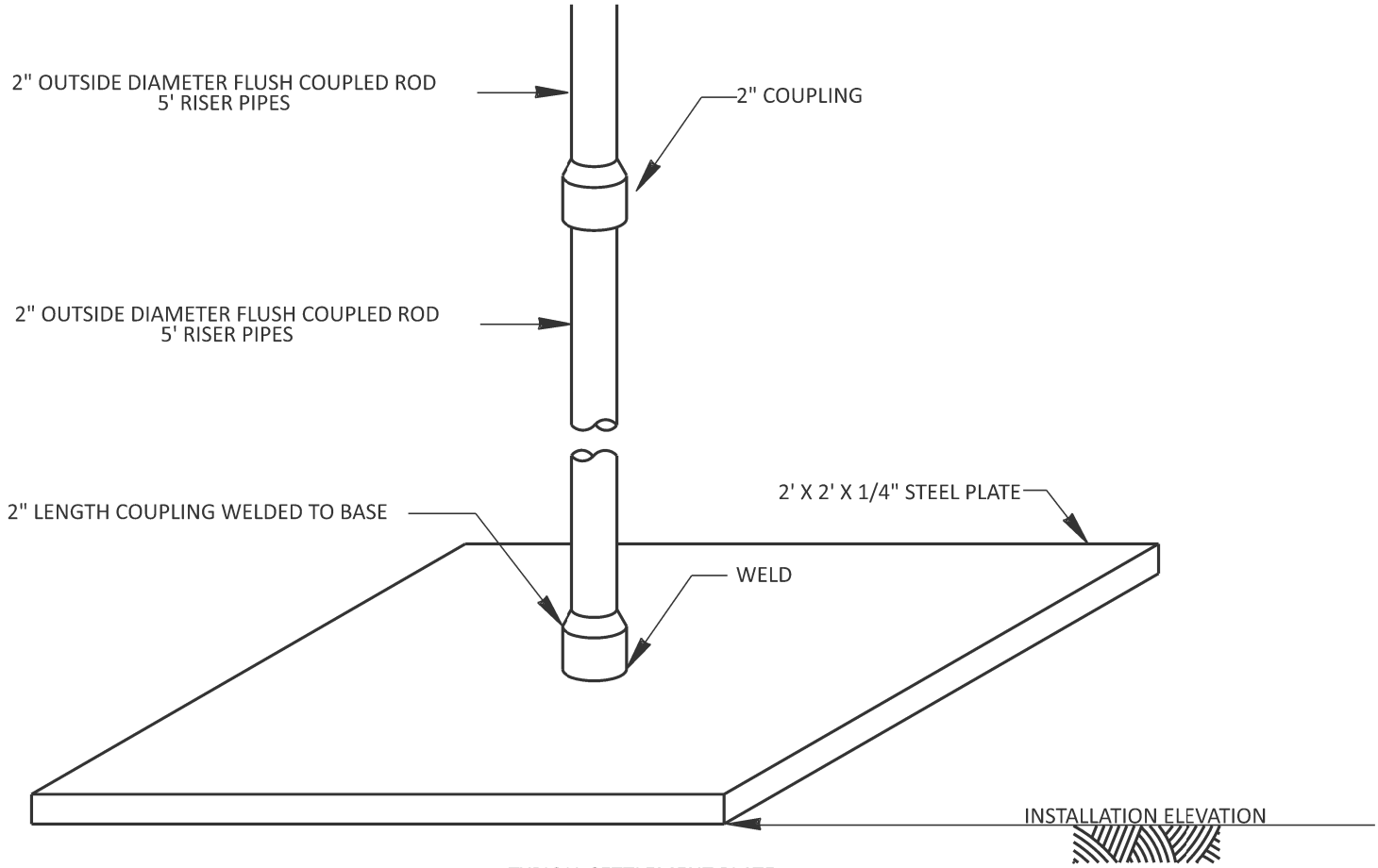
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-6.DGN	APPENDIX I

INSTALLATION DATE 24 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-7

G.P.S. COORDINATES 29.6102759, -90.7641553

INSTALLATION ELEVATION 5.93'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 5/8
2	59 1/8
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 25 MARCH 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION OF 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

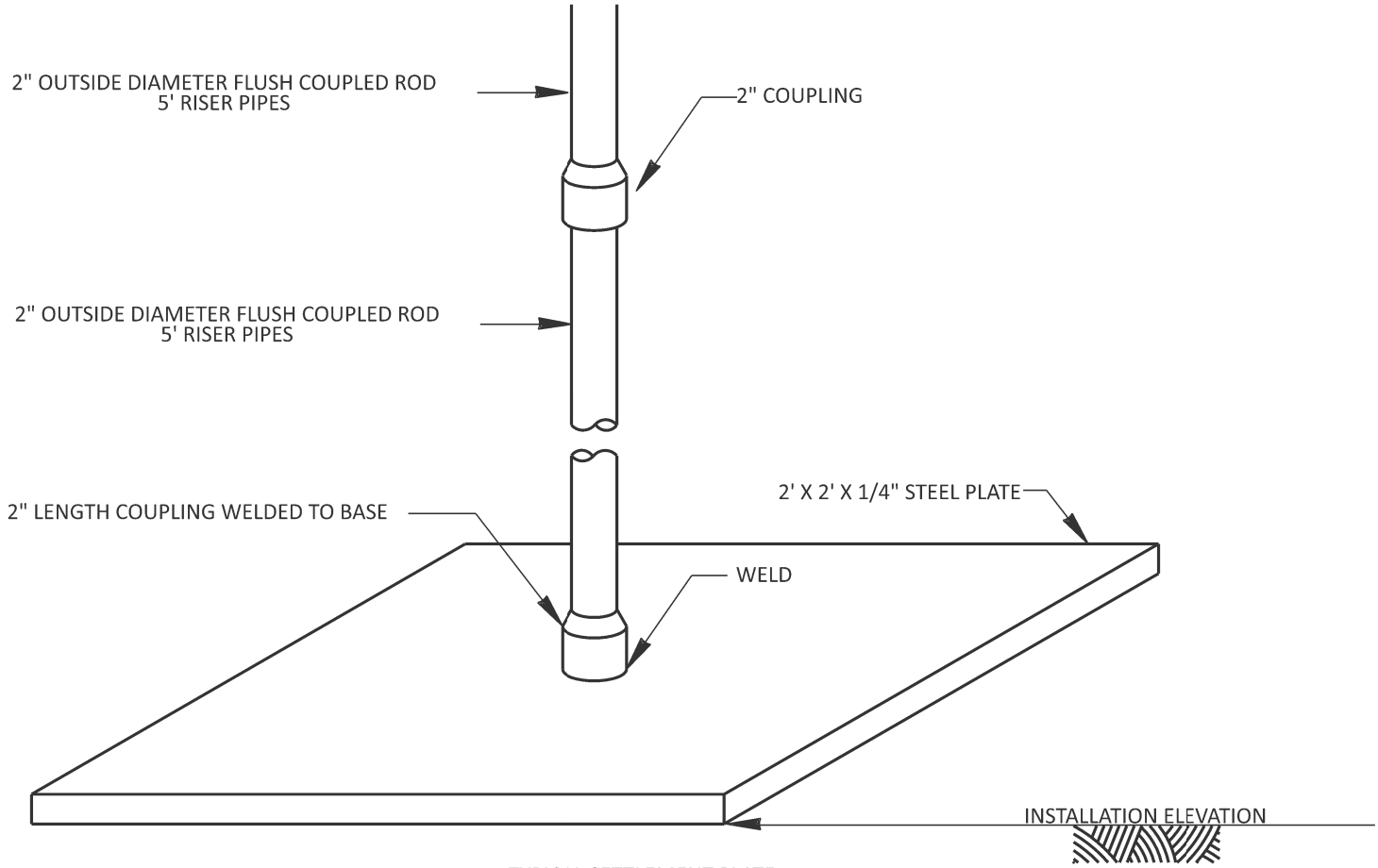
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-7.DGN	APPENDIX I

INSTALLATION DATE 20 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-8

G.P.S. COORDINATES 29.6106595, -90.7644581

INSTALLATION ELEVATION 5.69'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 1/2
2	59
3	
4	

NOTES:

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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

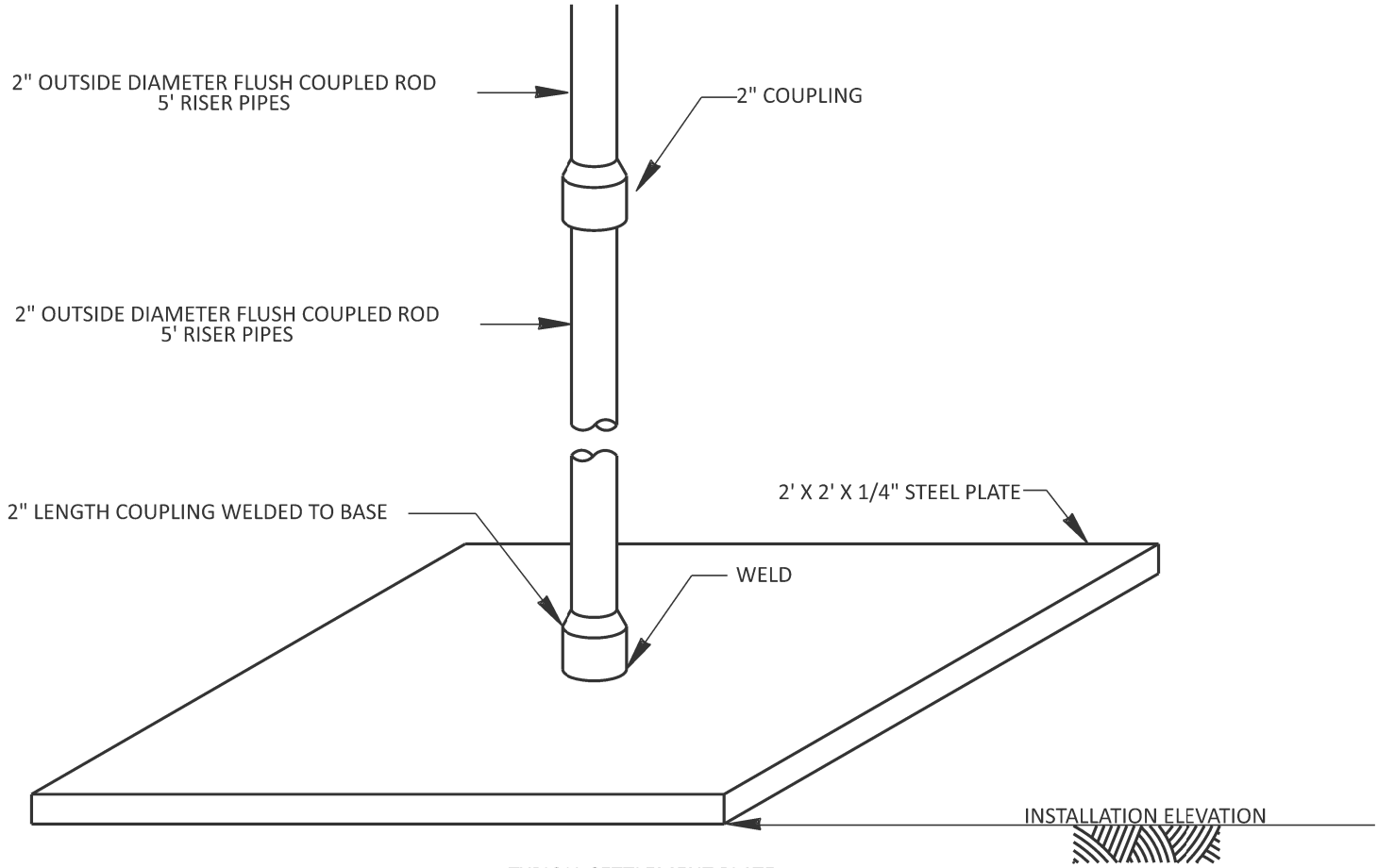
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-8.DGN	APPENDIX I

INSTALLATION DATE 24 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-9

G.P.S. COORDINATES 29.6103307, -90.7645241

INSTALLATION ELEVATION 6.02'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 1/2
2	59 1/8
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 25 MARCH 2025.
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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

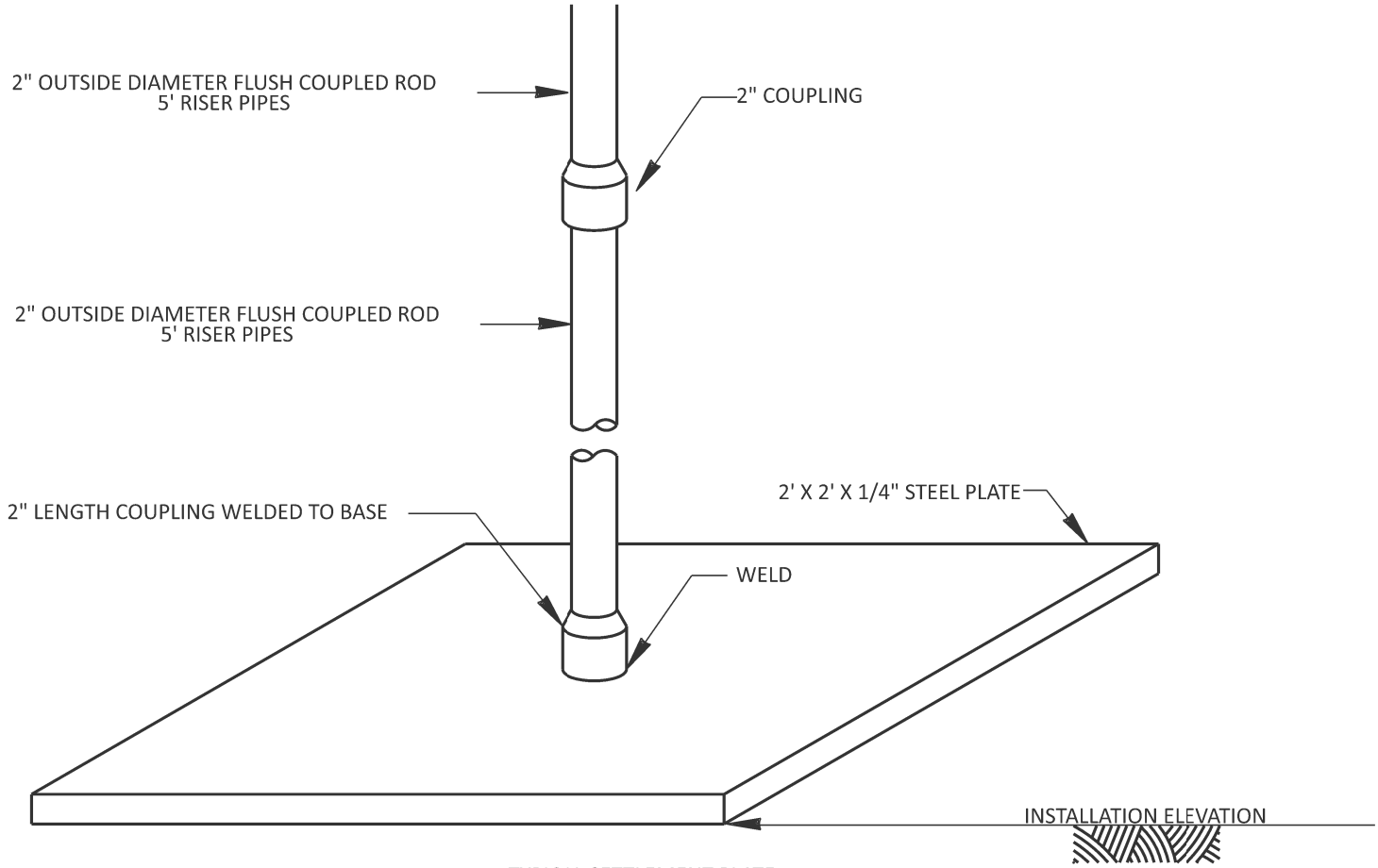
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-9.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-10

G.P.S. COORDINATES 29.6107744, -90.7657915

INSTALLATION ELEVATION 5.50'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 3/4
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 27 FEBRUARY 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

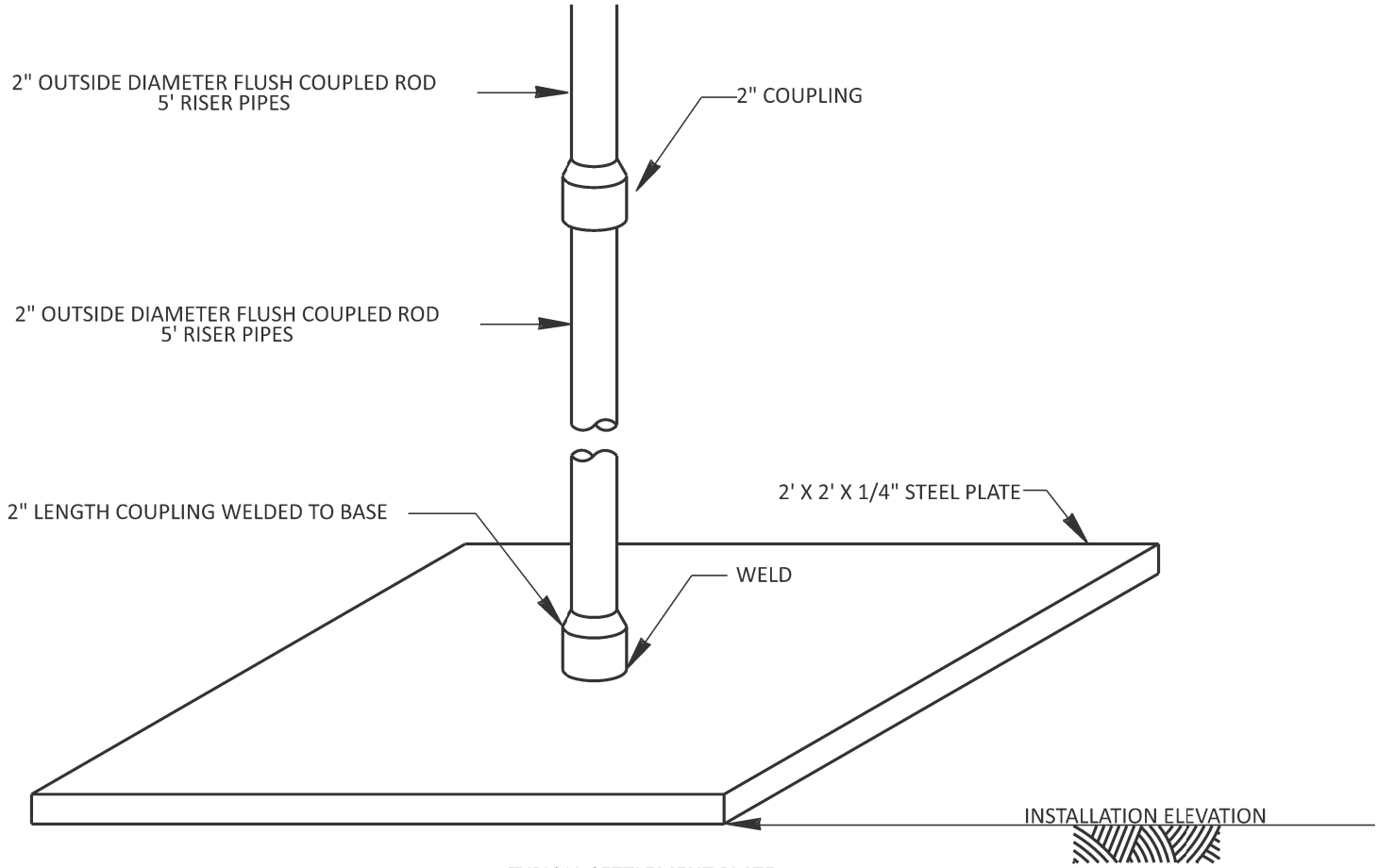
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-10.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-11

G.P.S. COORDINATES 29.6102853, -90.7655705

INSTALLATION ELEVATION 5.43'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	63
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 27 FEBRUARY 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

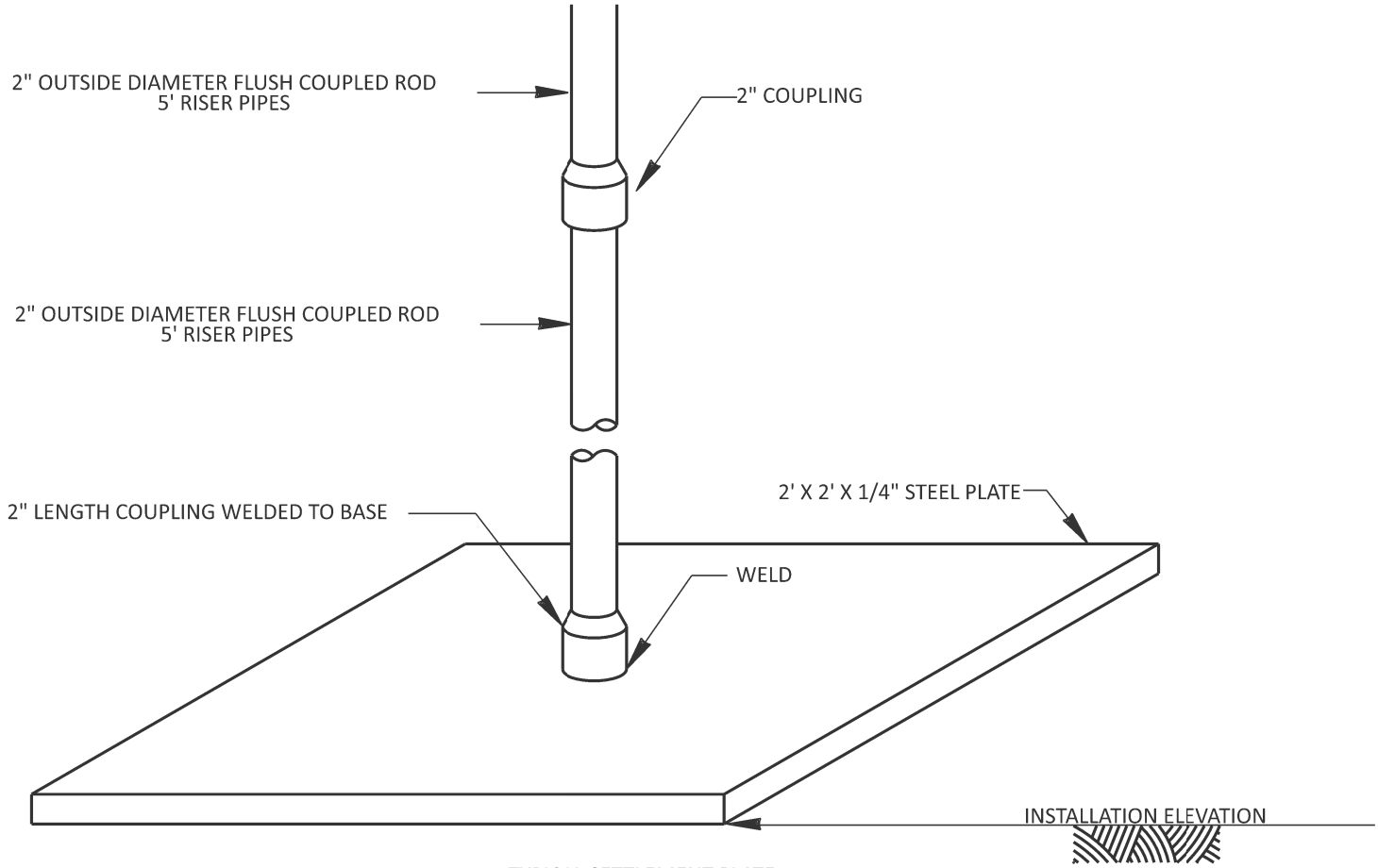
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-11.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-12

G.P.S. COORDINATES 29.6096040, -90.7653033

INSTALLATION ELEVATION 5.55'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 7/8
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 27 FEBRUARY 2025.
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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

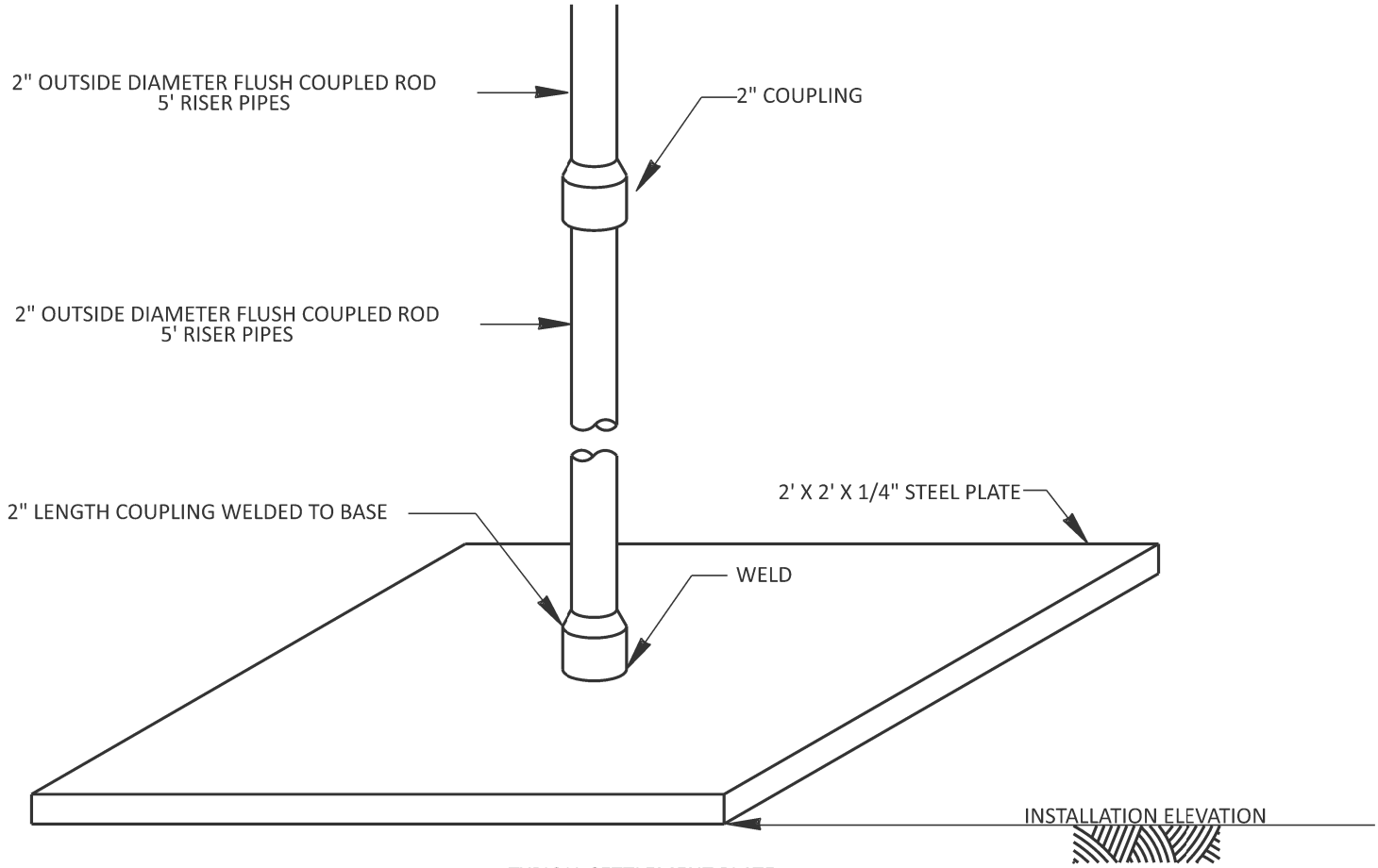
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-12.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-13

G.P.S. COORDINATES 29.6090706, -90.7651206

INSTALLATION ELEVATION 5.29'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 5/8
2	
3	
4	

NOTES:

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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

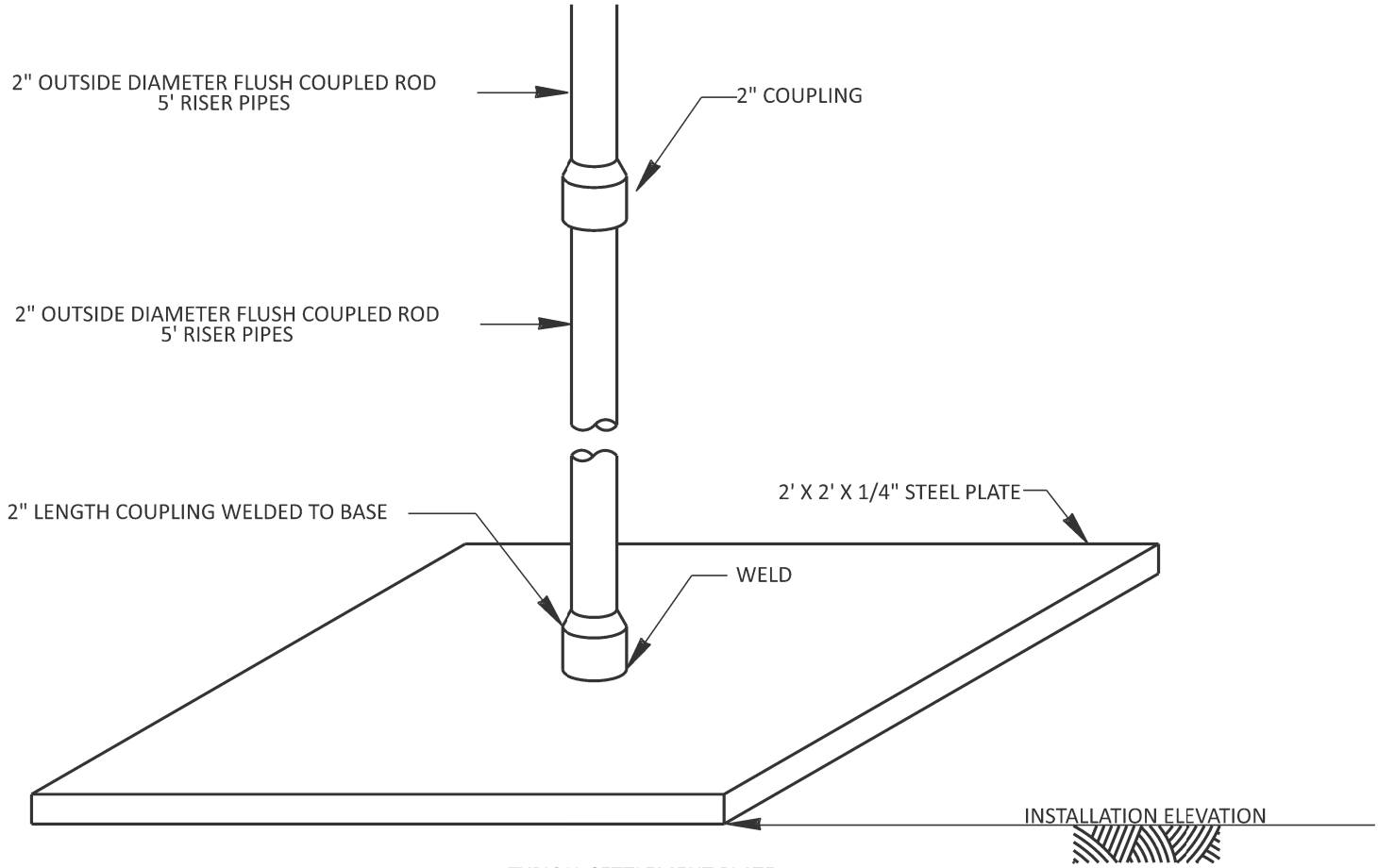
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-13.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-14

G.P.S. COORDINATES 29.6099591, -90.7647692

INSTALLATION ELEVATION 5.69'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 1/4
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 27 FEBRUARY 2025.
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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

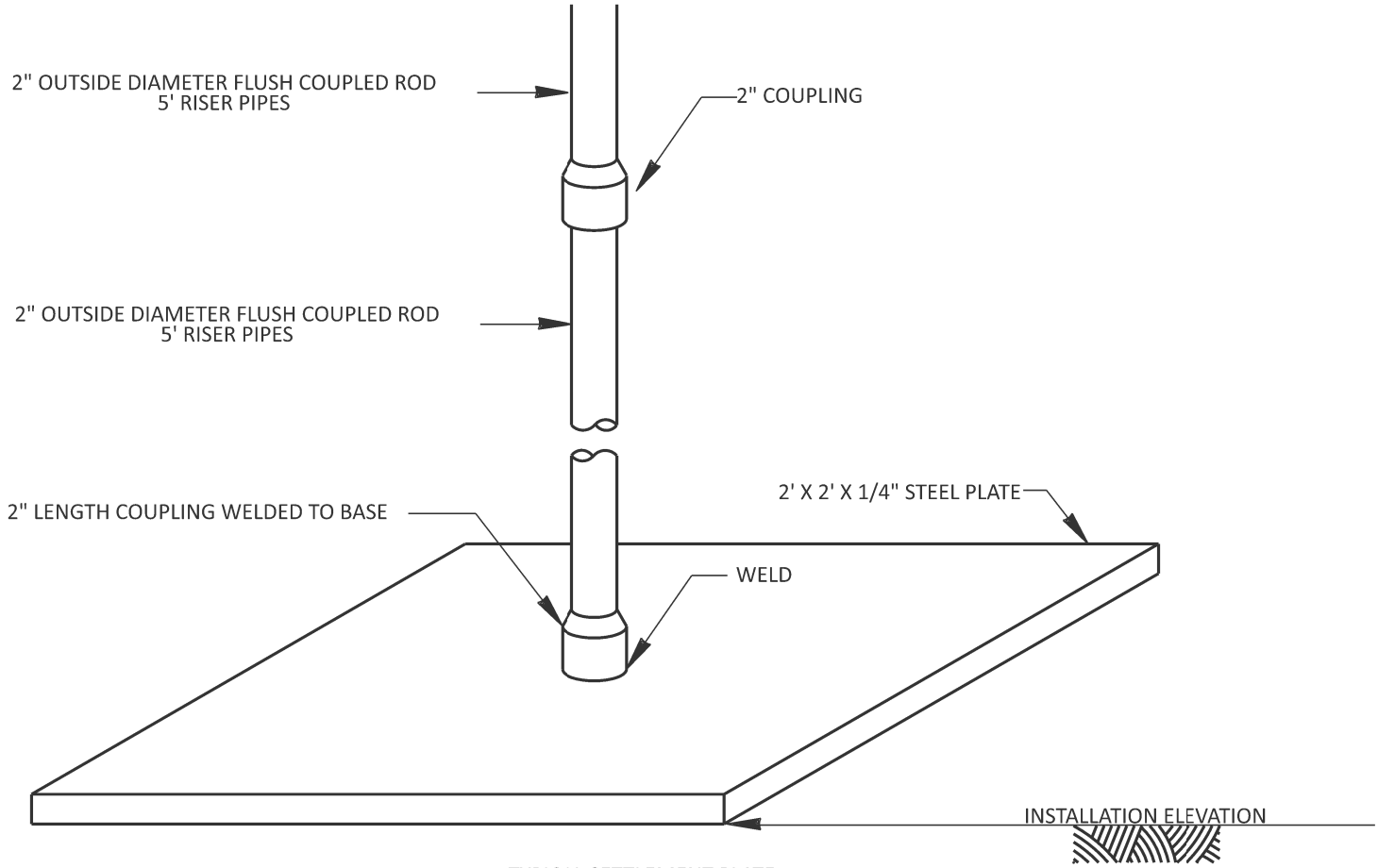
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-14.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-15

G.P.S. COORDINATES 29.6093563, -90.7645637

INSTALLATION ELEVATION 5.54'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 3/4
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 27 FEBRUARY 2025.
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SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

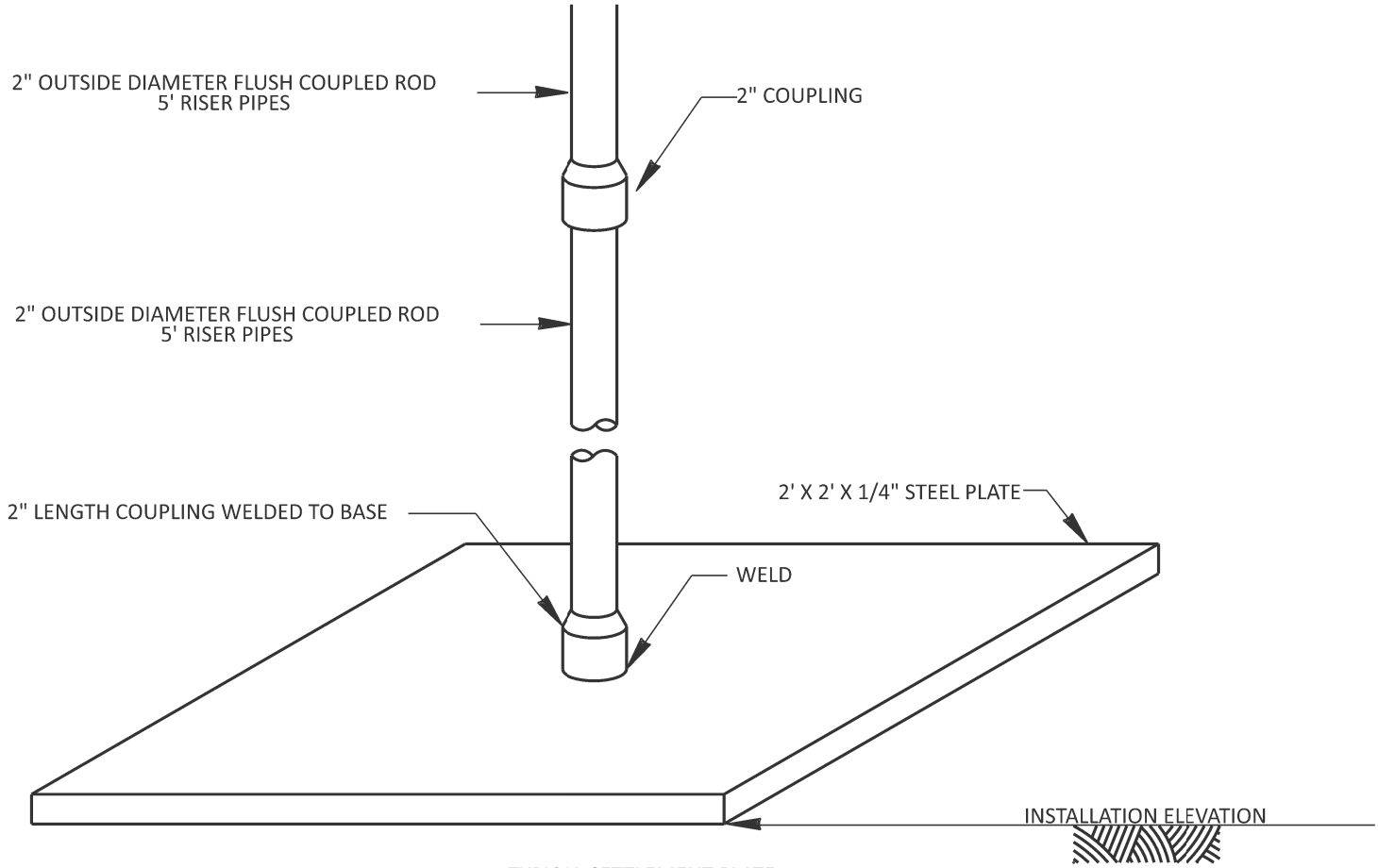
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-15.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

SETTLEMENT PLATE I.D. NUMBER SP-16

G.P.S. COORDINATES 29.6093155, -90.7641912

INSTALLATION ELEVATION 5.39'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 1/2
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 27 FEBRUARY 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

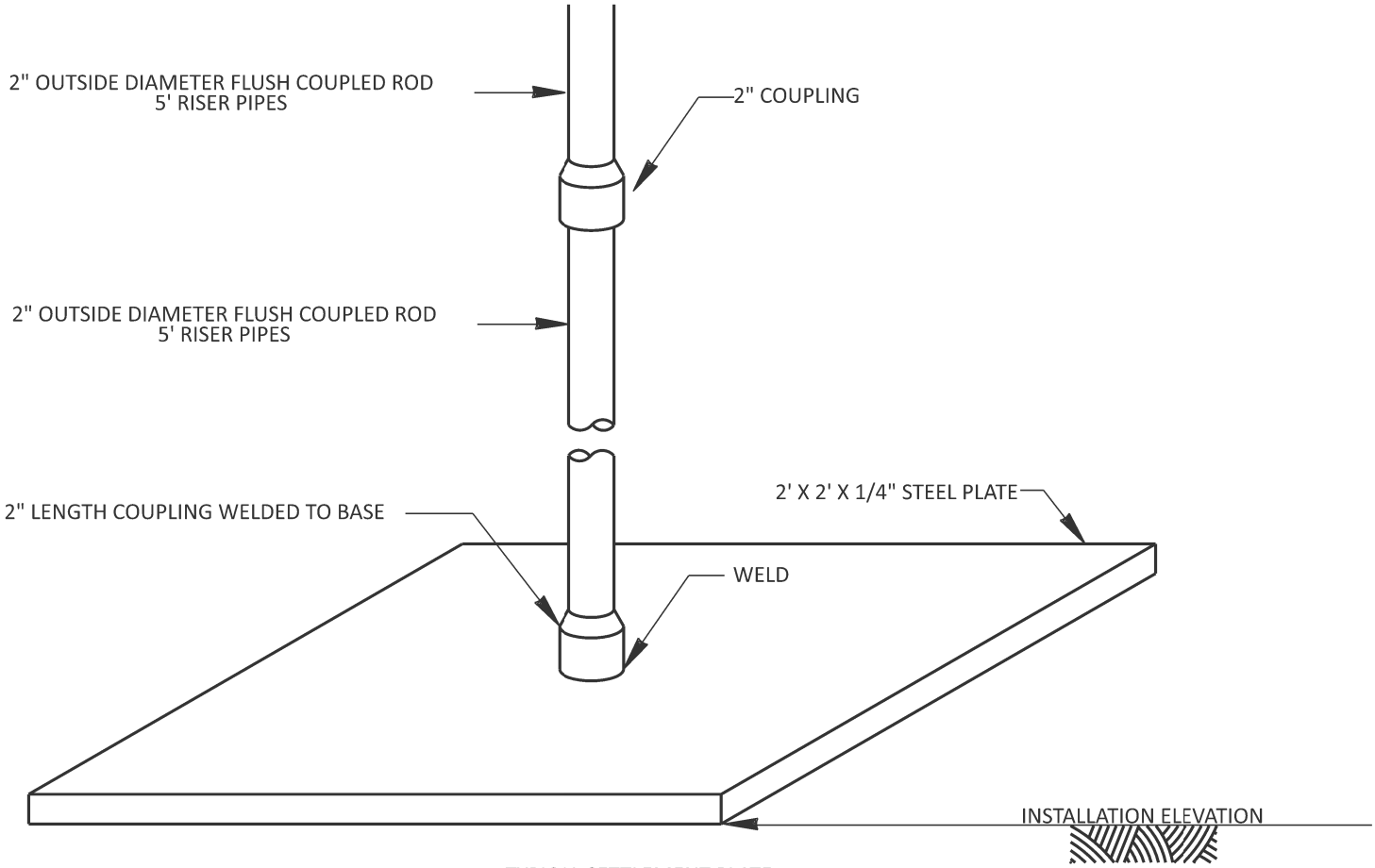
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-16.DGN	APPENDIX I

INSTALLATION DATE 24 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-17

G.P.S. COORDINATES 29.6097565, -90.7638881

INSTALLATION ELEVATION 5.35'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 3/4
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 25 MARCH 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENHCMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

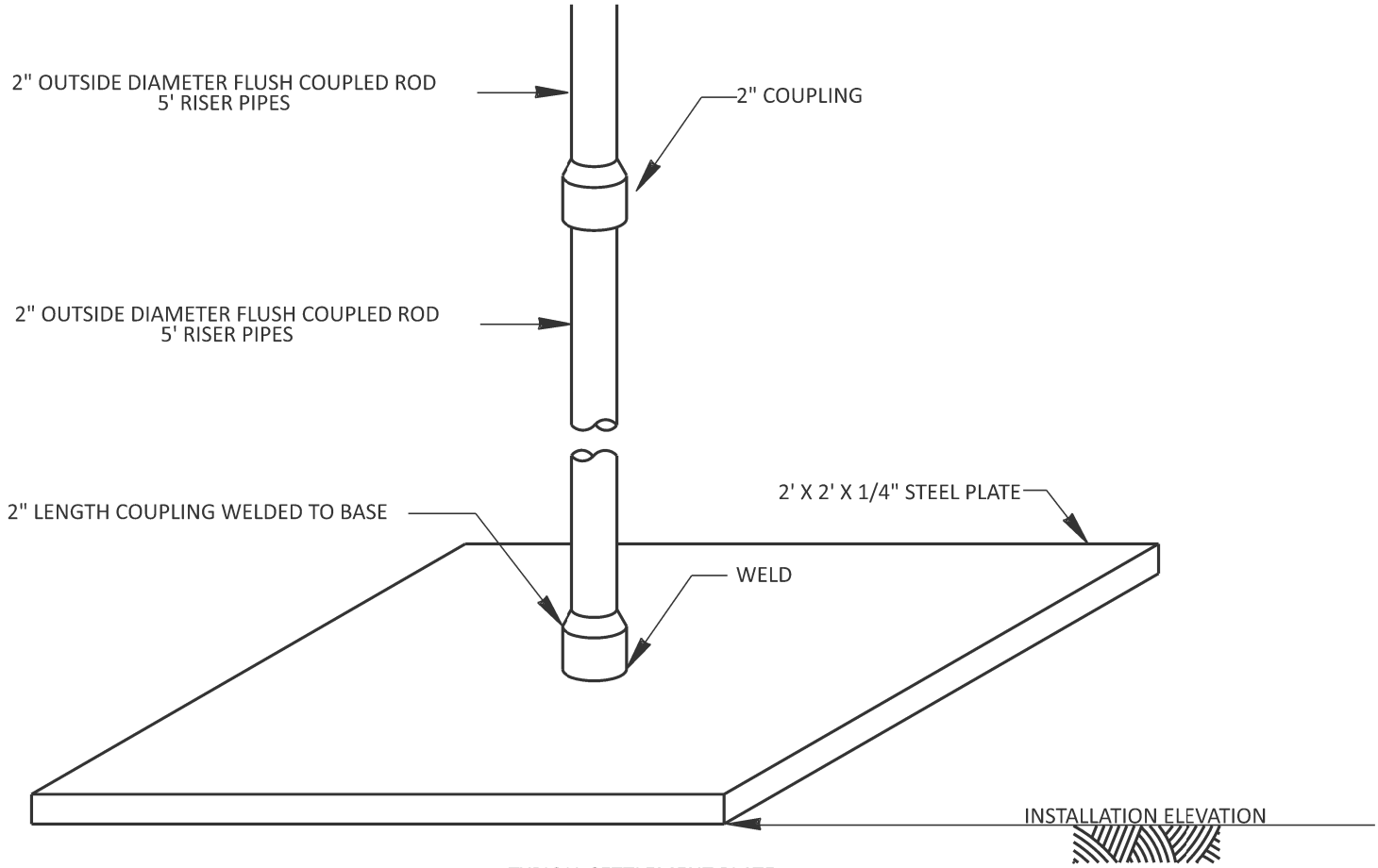
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-17.DGN	APPENDIX I

INSTALLATION DATE 24 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-18

G.P.S. COORDINATES 29.6104671, -90.7637925

INSTALLATION ELEVATION 5.75'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 7/8
2	59 1/4
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 25 MARCH 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

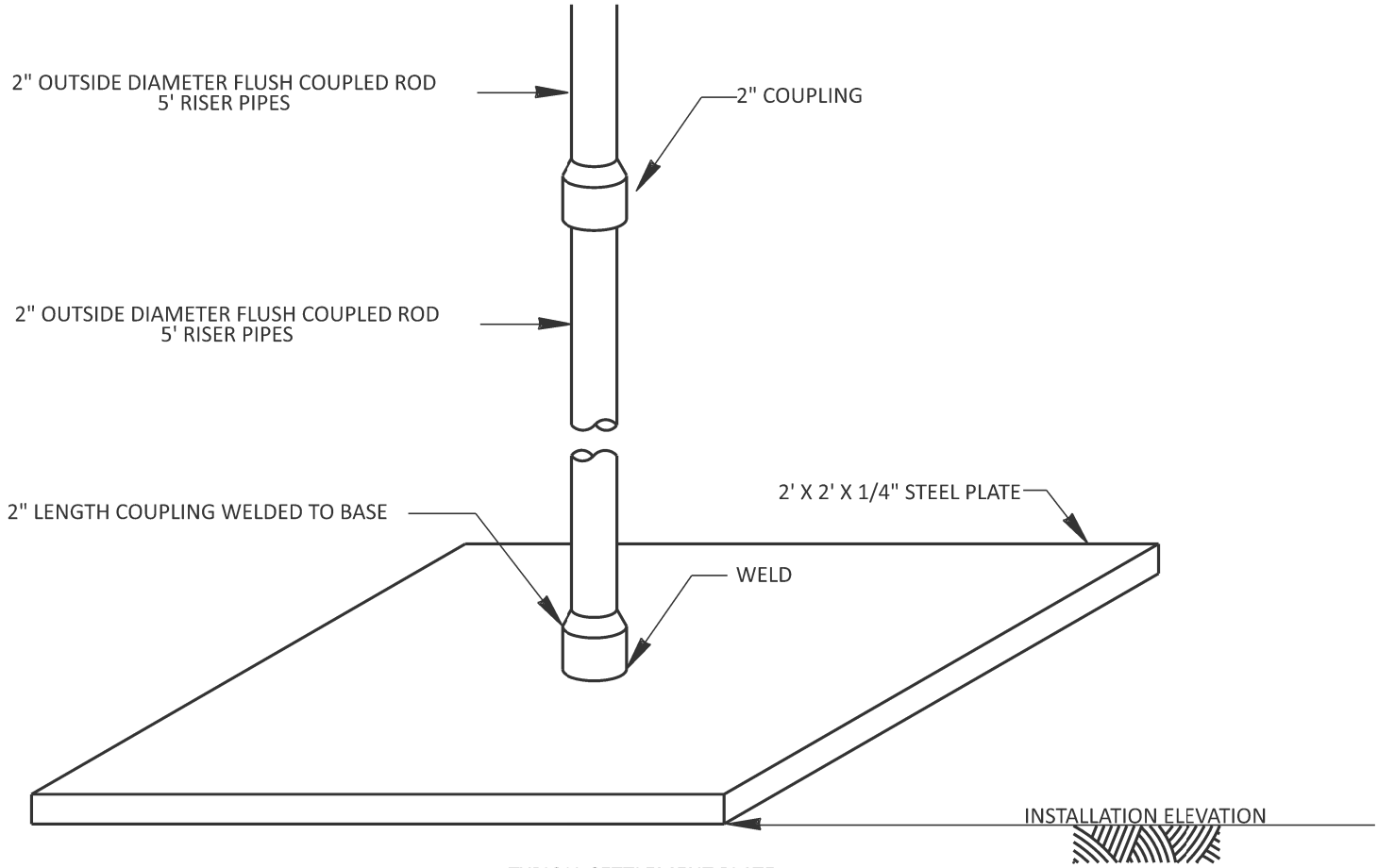
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-18.DGN	APPENDIX I

INSTALLATION DATE 13 MARCH 2025

SETTLEMENT PLATE I.D. NUMBER SP-19

G.P.S. COORDINATES 29.6100771, -90.7634076

INSTALLATION ELEVATION 5.36'



TYPICAL SETTLEMENT PLATE

RISER PIPE LENGTHS	
NO. OF PIPES	LENGTH IN INCHES
1	62 7/8
2	
3	
4	

NOTES:

1. SETTLEMENT PLATES WERE INITIALIZED ON 13 MARCH 2025.
2. SETTLEMENT PLATE INITIAL ELEVATIONS PRESENTED ABOVE ARE TIED TO A BENCHMARK ELEVATION 8.17'.

SETTLEMENT PLATE
INSTALLATION DETAIL SHEET

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

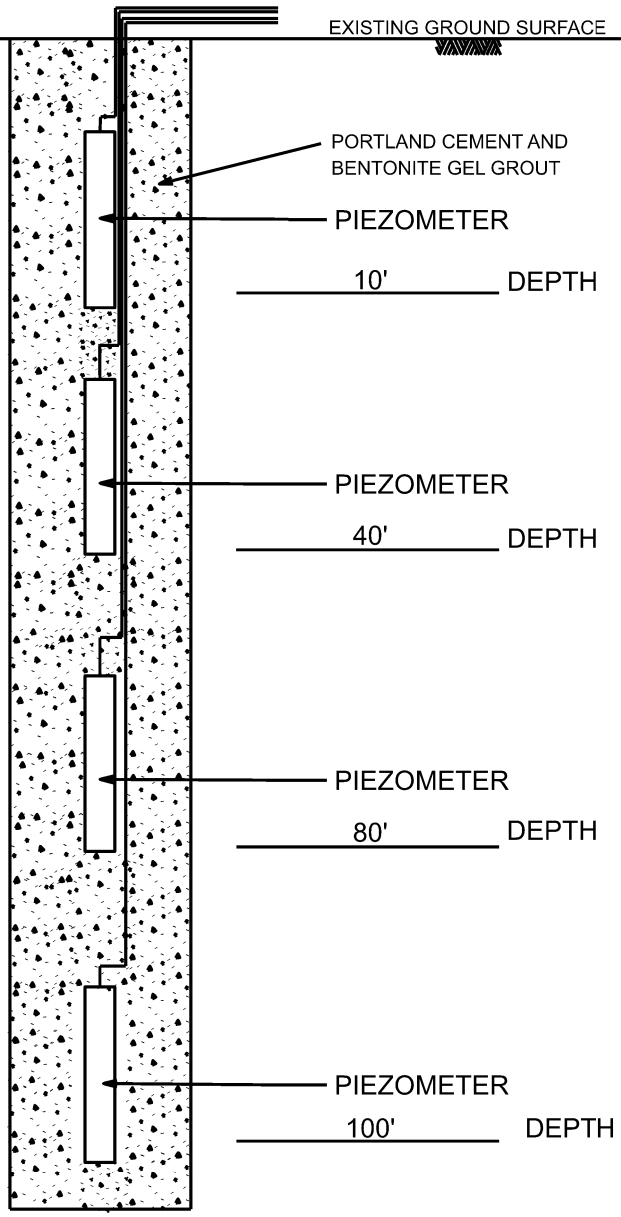
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: SP-19.DGN	APPENDIX I

INSTALLATION DATE 27 FEBRUARY 2025

PIEZOMETER I.D. NUMBER P - 1

COORDINATES 29.6113693 N, -90.7639642 W

GROUND SURFACE ELEVATION 2.53'



TRANSDUCER SERIAL NUMBER 2303966
INITIAL TEMPERATURE 20.5°C
INITIAL FREQUENCY READING 2599.1 Hz

TRANSDUCER SERIAL NUMBER 2400197
INITIAL TEMPERATURE 21.0°C
INITIAL FREQUENCY READING 2687.1 Hz

TRANSDUCER SERIAL NUMBER 2400393
INITIAL TEMPERATURE 20.7°C
INITIAL FREQUENCY READING 2202.2 Hz

TRANSDUCER SERIAL NUMBER 2304361
INITIAL TEMPERATURE 20.5°C
INITIAL FREQUENCY READING 2636.6 Hz

BOREHOLE BOTTOM DEPTH 105'

TYPICAL PIEZOMETER
NOT TO SCALE

REMARKS:

- GROUT/MUD WEIGHT = 1.20 S.G.
- INITIAL READINGS COLLECTED AT 8:45 A.M. ON 5 MARCH 2025.
- LOCATIONS WERE SURVEYED BY EUSTIS ENGINEERING ON 27 FEBRUARY 2025.
- ELEVATION OF PIEZOMETER NEST IS ASSOCIATED WITH THE NEAREST SETTLEMENT PLATE (SP-1) INITIAL ELEVATION. THIS ELEVATION IS TIED TO A BENCHMARK ELEVATION 8.17'.

PIEZOMETER DATA SHEET
P - 1

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
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HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

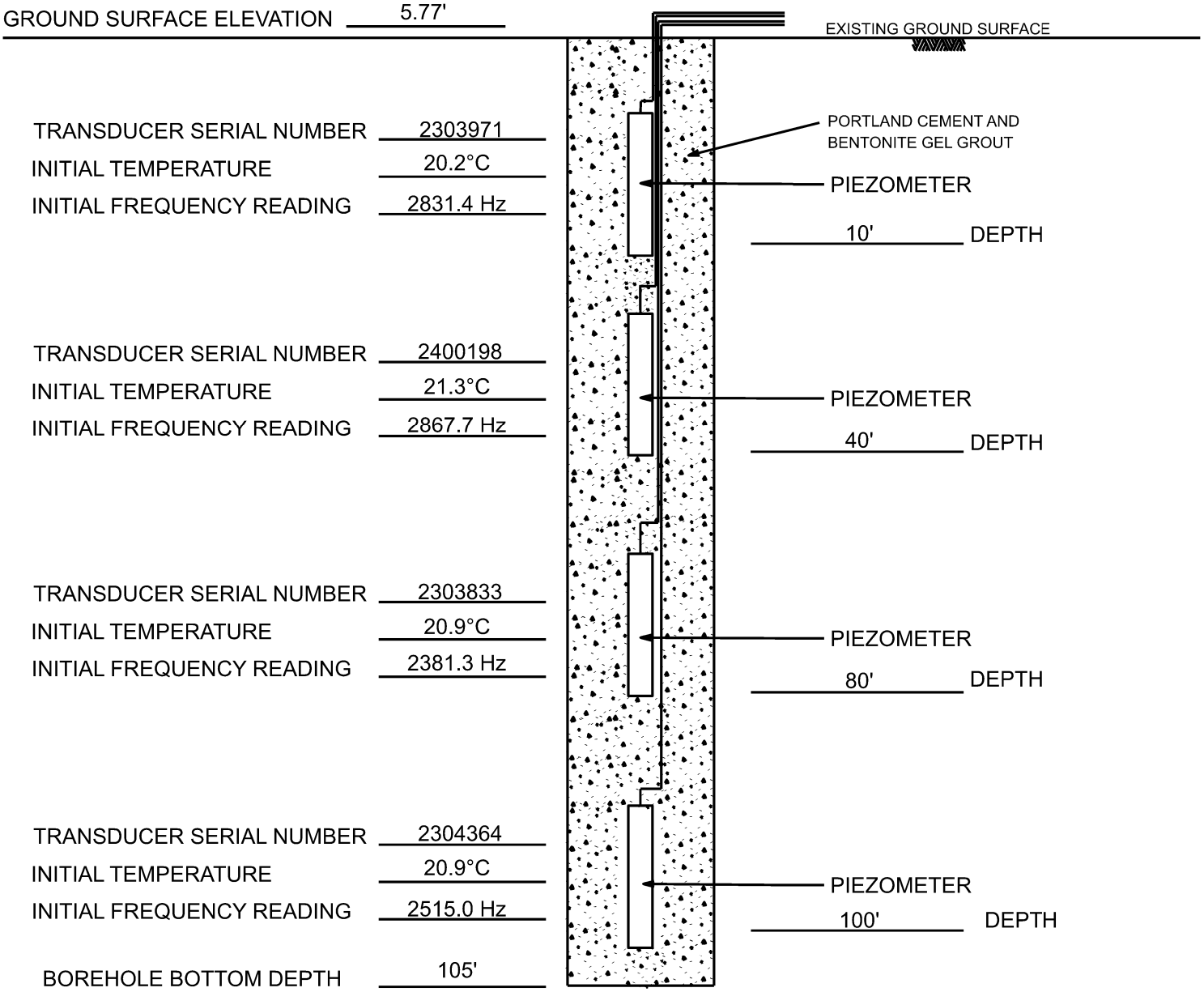
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: VWP - P1.DGN	APPENDIX I

INSTALLATION DATE 17 MARCH 2025

COORDINATES 29.6111230 N, -90.7646170 W

GROUND SURFACE ELEVATION 5.77'

PIEZOMETER I.D. NUMBER P - 2



TYPICAL PIEZOMETER
NOT TO SCALE

REMARKS:

- GROUT/MUD WEIGHT = 1.16 S.G.
- INITIAL READINGS COLLECTED AT 8:30 A.M. ON 19 MARCH 2025.
- LOCATIONS WERE SURVEYED BY EUSTIS ENGINEERING ON 17 MARCH 2025.
- ELEVATION OF PIEZOMETER NEST IS ASSOCIATED WITH THE NEAREST SETTLEMENT PLATE (SP-2) INITIAL ELEVATION. THIS ELEVATION IS TIED TO A BENCHMARK ELEVATION 8.17'.

PIEZOMETER DATA SHEET
P - 2

TERREBONNE GENERAL MEDICAL CENTER
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HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

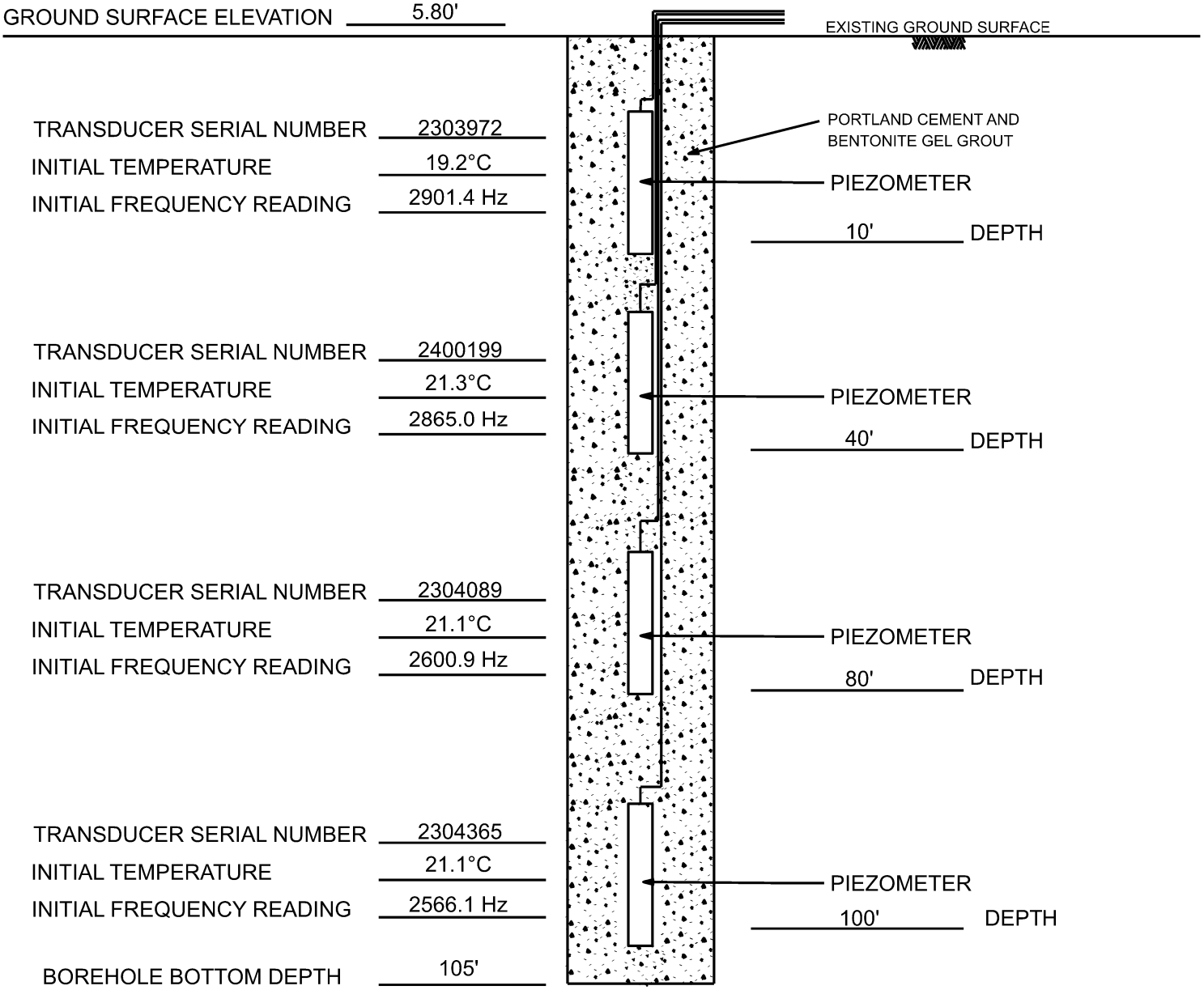
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: VWP - P2.DGN	APPENDIX I

INSTALLATION DATE 19 MARCH 2025

COORDINATES 29.6108863 N, -90.7651953 W

GROUND SURFACE ELEVATION 5.80'

PIEZOMETER I.D. NUMBER P - 3



TYPICAL PIEZOMETER
NOT TO SCALE

REMARKS:

- GROUT/MUD WEIGHT = 1.16 S.G.
- INITIAL READINGS COLLECTED AT 8:30 A.M. ON 21 MARCH 2025.
- LOCATIONS WERE SURVEYED BY EUSTIS ENGINEERING ON 17 MARCH 2025.
- ELEVATION OF PIEZOMETER NEST IS ASSOCIATED WITH THE NEAREST SETTLEMENT PLATE (SP-3) INITIAL ELEVATION. THIS ELEVATION IS TIED TO A BENCHMARK ELEVATION 8.17'.

PIEZOMETER DATA SHEET
P - 3

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

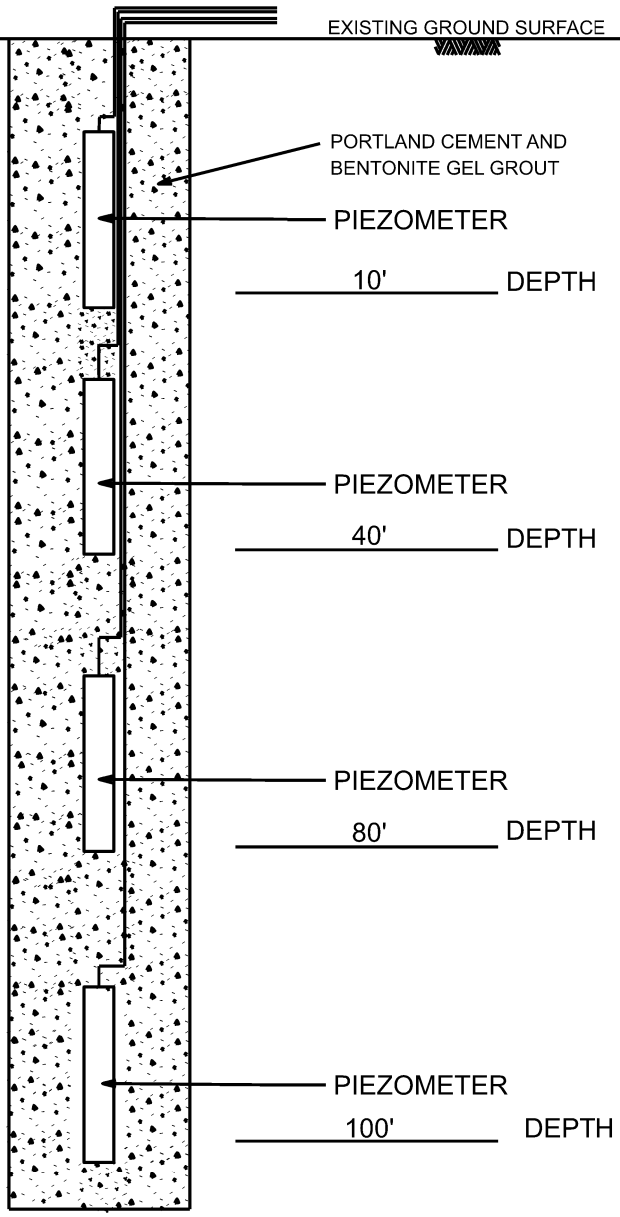
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: VWP - P3.DGN	APPENDIX I

INSTALLATION DATE 18 MARCH 2025

PIEZOMETER I.D. NUMBER P - 4

COORDINATES 29.6108627 N, -90.7648487 W

GROUND SURFACE ELEVATION 5.74'



TRANSDUCER SERIAL NUMBER 2303973
INITIAL TEMPERATURE 19.3°C
INITIAL FREQUENCY READING 3006.8 Hz

TRANSDUCER SERIAL NUMBER 2400200
INITIAL TEMPERATURE 21.1°C
INITIAL FREQUENCY READING 2310.1 Hz

TRANSDUCER SERIAL NUMBER 2303837
INITIAL TEMPERATURE 20.9°C
INITIAL FREQUENCY READING 2609.3 Hz

TRANSDUCER SERIAL NUMBER 2304366
INITIAL TEMPERATURE 20.8°C
INITIAL FREQUENCY READING 2577.4 Hz

BOREHOLE BOTTOM DEPTH 105'

TYPICAL PIEZOMETER
NOT TO SCALE

REMARKS:

- GROUT/MUD WEIGHT = 1.20 S.G.
- INITIAL READINGS COLLECTED AT 9:30 A.M. ON 20 MARCH 2025.
- LOCATIONS WERE SURVEYED BY EUSTIS ENGINEERING ON 17 MARCH 2025.
- ELEVATION OF PIEZOMETER NEST IS ASSOCIATED WITH THE NEAREST SETTLEMENT PLATE (SP-4) INITIAL ELEVATION. THIS ELEVATION IS TIED TO A BENCHMARK ELEVATION 8.17'.

PIEZOMETER DATA SHEET
P - 4

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

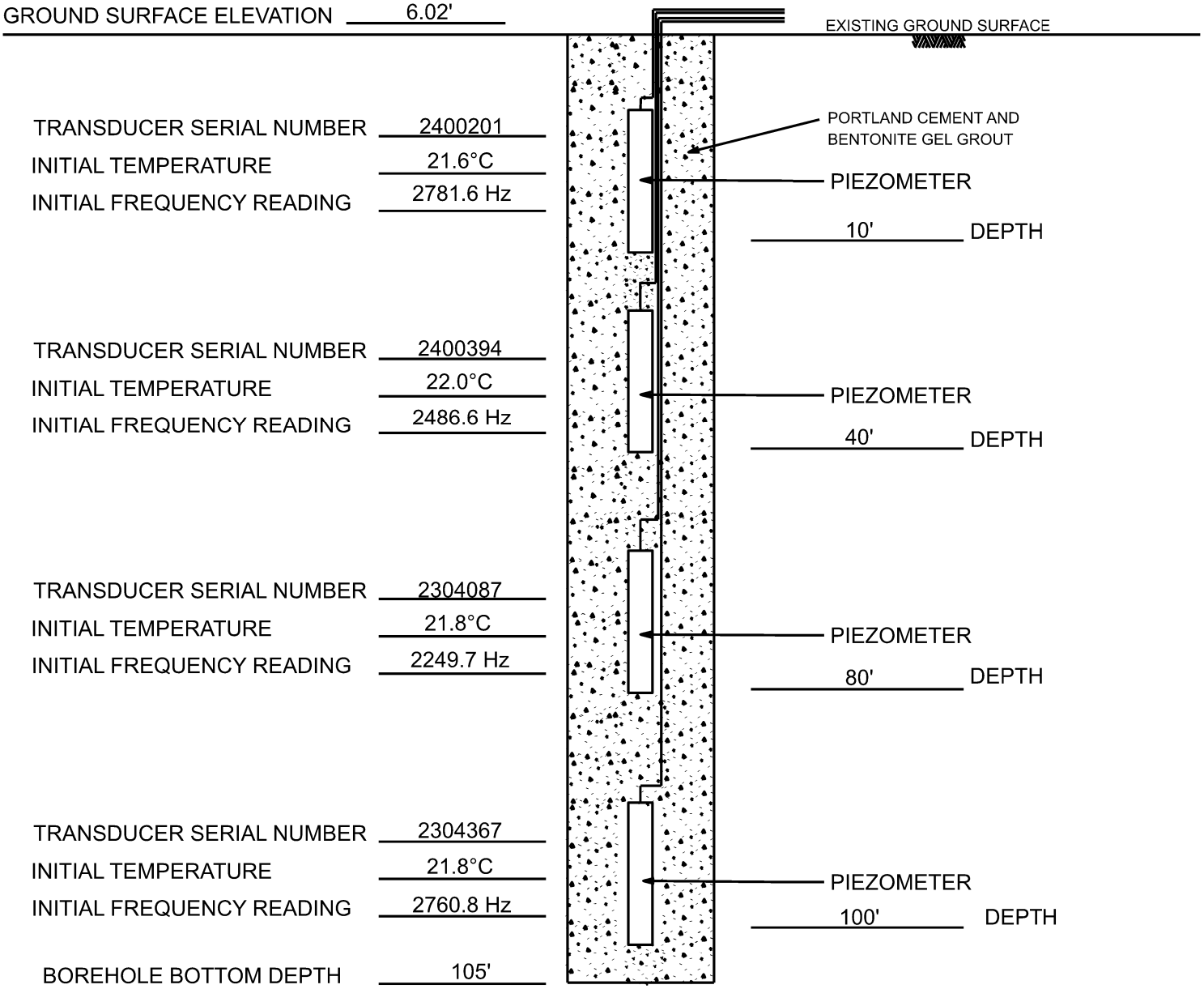
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R	DATE: 30 APR 2025
CADD FILE: VWP - P4.DGN	APPENDIX I

INSTALLATION DATE 25 MARCH 2025

COORDINATES 29.6103430 N, -90.7645080 W

GROUND SURFACE ELEVATION 6.02'

PIEZOMETER I.D. NUMBER P - 5



TYPICAL PIEZOMETER
NOT TO SCALE

REMARKS:

- GROUT/MUD WEIGHT = 1.20 S.G.
- INITIAL READINGS COLLECTED AT 9:00 A.M ON 26 MARCH 2025.
- LOCATIONS WERE SURVEYED BY EUSTIS ENGINEERING ON 25 MARCH 2025.
- ELEVATION OF PIEZOMETER NEST IS ASSOCIATED WITH THE NEAREST SETTLEMENT PLATE (SP-9) INITIAL ELEVATION. THIS ELEVATION IS TIED TO A BENCHMARK ELEVATION 8.17'.
- PIEZOMETER NEST LOCATION MOVED TO NEAR SP-9.

PIEZOMETER DATA SHEET
P - 5

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
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HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

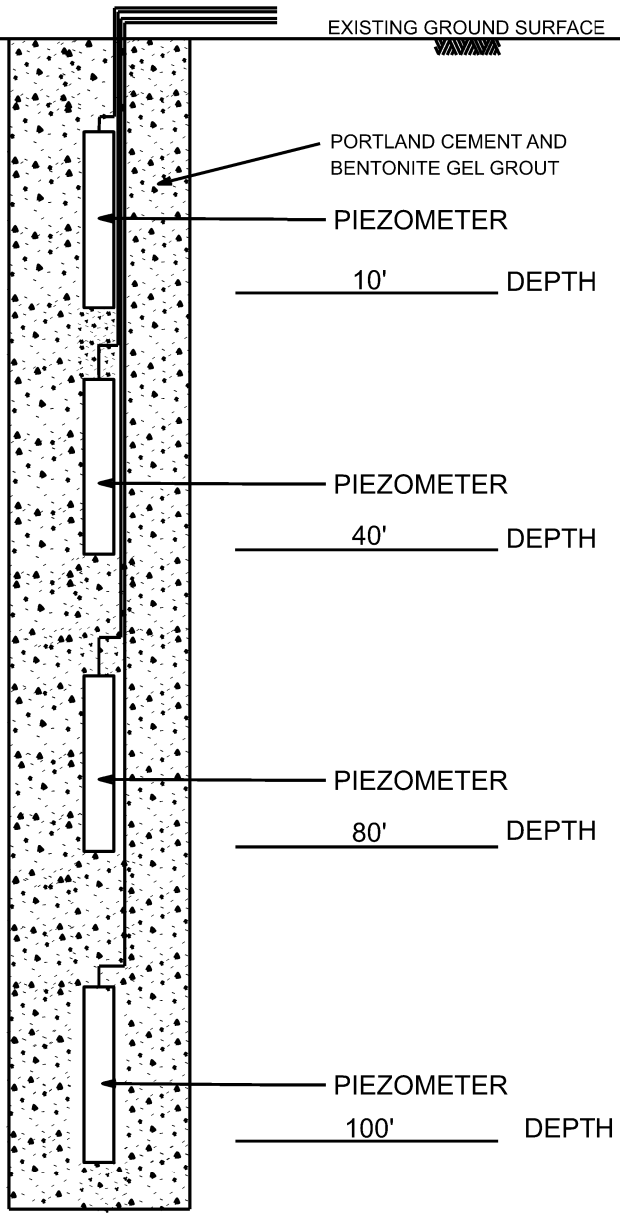
DRAWN BY: A.E.R.	JOB NO.: 24717.03
CHECKED BY: T.R.R	DATE: 30 APR 2025
CADD FILE: VWP - P5.DGN	APPENDIX I

INSTALLATION DATE 22 MARCH 2025

COORDINATES 29.6103675 N, -90.7649855 W

GROUND SURFACE ELEVATION 5.44'

PIEZOMETER I.D. NUMBER P - 6



TRANSDUCER SERIAL NUMBER 2400387
INITIAL TEMPERATURE 19.3°C
INITIAL FREQUENCY READING 3005.1 Hz

TRANSDUCER SERIAL NUMBER 2400395
INITIAL TEMPERATURE 20.1°C
INITIAL FREQUENCY READING 2663.4 Hz

TRANSDUCER SERIAL NUMBER 2304088
INITIAL TEMPERATURE 20.3°C
INITIAL FREQUENCY READING 2720.8 Hz

TRANSDUCER SERIAL NUMBER 2303835
INITIAL TEMPERATURE 20.2°C
INITIAL FREQUENCY READING 2450.7 Hz

BOREHOLE BOTTOM DEPTH 105'

TYPICAL PIEZOMETER
NOT TO SCALE

REMARKS:

- GROUT/MUD WEIGHT= 1.20 S.G.
- INITIAL READINGS COLLECTED AT 11:30 A.M. ON 22 MARCH 2025.
- LOCATIONS WERE SURVEYED BY EUSTIS ENGINEERING ON 21 MARCH 2025 .
- ELEVATION OF PIEZOMETER NEST IS ASSOCIATED WITH THE NEAREST SETTLEMENT PLATE (SP-6) INITIAL ELEVATION. ELEVATION IS TIED TO A BENCHMARK ELEVATION 8.17'.

PIEZOMETER DATA SHEET
P - 6

TERREBONNE GENERAL MEDICAL CENTER
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HOUMA (TERREBONNE PARISH), LOUISIANA

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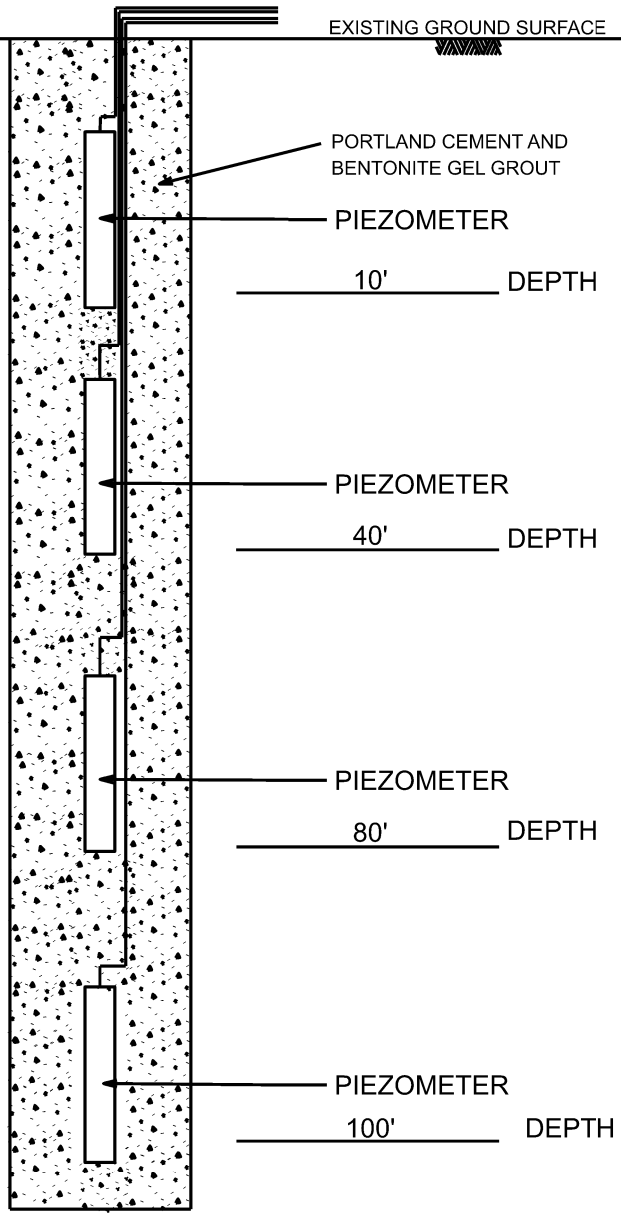
CHECKED BY: T.R.R.	DATE: 30 APR 2025
CADD FILE: VWP - P6.DGN	APPENDIX I

INSTALLATION DATE 22 MARCH 2025

PIEZOMETER I.D. NUMBER P - 7

COORDINATES 29.6102917 N, -90.7641449 W

GROUND SURFACE ELEVATION 5.93'



TRANSDUCER SERIAL NUMBER 2400392
INITIAL TEMPERATURE 18.8°C
INITIAL FREQUENCY READING 2984.4 Hz

TRANSDUCER SERIAL NUMBER 2400396
INITIAL TEMPERATURE 21.1°C
INITIAL FREQUENCY READING 2555.9 Hz

TRANSDUCER SERIAL NUMBER 2304084
INITIAL TEMPERATURE 20.8°C
INITIAL FREQUENCY READING 2449.2 Hz

TRANSDUCER SERIAL NUMBER 2304090
INITIAL TEMPERATURE 20.7°C
INITIAL FREQUENCY READING 2429.2 Hz

BOREHOLE BOTTOM DEPTH 105'

TYPICAL PIEZOMETER
NOT TO SCALE

REMARKS:

- GROUT/MUD WEIGHT = 1.16 S.G.
- INITIAL READINGS COLLECTED AT 1:45 P.M. ON 25 MARCH 2025.
- LOCATIONS WERE SURVEYED BY EUSTIS ENGINEERING ON 22 MARCH 2025.
- ELEVATION OF PIEZOMETER NEST IS ASSOCIATED WITH THE NEAREST SETTLEMENT PALTE (SP-7) INITIAL ELEVATION. THIS ELEVATION IS TIED TO A BENCHMARK ELEVATION 8.17'.

PIEZOMETER DATA SHEET
P - 7

TERREBONNE GENERAL MEDICAL CENTER
SURCHARGE MONITORING PROGRAM
PROPOSED HEALTH AND WELLNESS CENTER
HOUMA (TERREBONNE PARISH), LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.E.R.	JOB NO.: 24717.03
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CADD FILE: VWP - P7.DGN	APPENDIX I

APPENDIX II

Cement-Bentonite Grout Backfill for Borehole Instruments

P. Erik Mikkelsen

The backfill for a borehole instrument is often an item that receives a disproportionate lack of attention. The behavior of the backfill, the material that is in the most intimate contact with both the formation and the instrument, is critical for obtaining correct measurements. In many situations, instrument observations may just reflect unstable backfill, lack of backfill or backfill that is too stiff or too soft. Sand, gravel and various bentonite products have proven to be both too difficult to place and often entirely inappropriate. Experience has shown the author that cement-bentonite grout is the most universally applicable material for successfully backfilling a borehole instrument. Single-component bentonite grouts have been used in related industries a long time, and have been adopted for borehole instrumentation with mixed success. Their uses are more involved and, as explained below, should be avoided. The use of fly ash as a substitute for cement promises to be a good way for reducing grout stiffness when required.

Current Use of Bentonite

Materials and Technology

Although this article advocates the use of cement-bentonite grout it is appropriate to review current bentonite backfill and sealing products to illustrate why their use should be limited. To the uninitiated, there is a confusing array of various pellets, chips, granulated and powder-forms of sodium bentonite commercially available in North America and elsewhere. Calcium type montmorillonite and opalite are also used. The proper use of these products is a mature and complex technology employed by the environmental, water-well and petroleum industries. Basic research has been done and their properties are known. For example, Baroid Industrial Products (1994), a manufacturer of about two-dozen drilling-products gives a five-day workshop in Houston, Texas including a hands-on laboratory day. Here, the user learns about the difference between drilling muds and bentonite used for sealing (single-component grouts) and how to place the materials. However, drillers and geo-professionals who install piezometers and other borehole instruments for the geotechnical industry generally do not have this background and often have limited understanding of bentonite products outside of powder used to make mud and dropping chips down the hole. Going "high-tech" requires more knowledge, better equipment, and a higher level of quality control, which appears to be unrealistic for borehole instrumentation.

Solid Bentonite Seals

Installation of bentonite balls, pellets or chips as seals above a sand pocket have dominated piezometer installation procedures over the last 50 years. It is classic procedure for open standpipe piezometers. Installation is usually very time consuming, particularly on deeper boreholes or when caving occurs. When you manage to get such seals installed without bridging the hole, there is usually no question about their permeability being adequately low. These seals have a very low permeability, often lower than many in-situ clays. Establishment of proper procedures for placement of such materials has been important not only because sealing is important, but also because the installation conditions are often difficult and the procedures cumbersome. Many installations end up less than satisfactory. Over the last decade, experience has shown that bentonite chips (as opposed to balls and pellets) are the easiest to place. These chips look like crushed gravel and hydrate very slowly. However, the fine clay-dust unavoidably mixed in with the chips can make conditions increasingly sticky as filling proceeds, leading to bridging and blockage higher in the borehole. For relatively simple installations where the seal heights and volumes are not too extensive, this material usually does not bridge and is often the seal of choice for environmental observation wells and open standpipe piezometers.

Pellets, chips and polymer-suspended granules can also be tremied to the desired location in the boring. The potential for clogging is always a hazard, but at least a clogged tremie-pipe can be withdrawn and discarded. If clogging or bridging occurs while dropping the ma-

terials directly into the borehole, there is no recourse except to start over.

Bentonite Grouts

These products are the least desirable for sealing or backfilling. They are made from water and powdered bentonite mixed into slurry-like drilling mud, but to a higher density with the aid of additives and specialized grout mixing units. The higher the bentonite solids-content is, the lower the permeability is. The water-content of such slurry is extremely high and it never really sets up to anything more than thick paste, not a solid like the chip-seals. A number of bentonite sealing grouts are available, but none appear to set up to a solid form. They are sensitive to over-mixing (leading to a flash set) and can be difficult to pump down the small diameter grout pipes (3/4 inch) often used for piezometers and other geotechnical borehole instruments where space is at a premium. Their working time tends to be too short, and mix dilution to circumvent mixing and pumping problems will lead to a permanently soupy backfill.

Cement-Bentonite Grouts

Basics

A bentonite grout backfill consisting of just bentonite and water may not be volumetrically stable and introduces uncertainty about locally introduced pore water pressures caused by the hydration process. Introducing cement, even a small amount, reduces the expansive properties of the bentonite component once the cement-bentonite grout takes an initial set. The strength of the set grout can be designed to be similar to the surrounding ground by controlling the cement content and adjusting the mix proportions. Controlling the compressibility (modulus) and the permeability is not so easy. Weaker cementitious grouts tend to remain much stiffer than normally consolidated clays of similar strengths. The bentonite solids content has the greatest influence on the permeability of cement-bentonite grout, not the cement content.

Cement-bentonite grouts are easier to use than bentonite grouts, provide a long working time before set and are more forgiving should the user deviate from the design recipe or mixing equipment and method. It is easier to adjust the grout mix for variations in temperature, pH and cleanliness of the water. Pure bentonite grouts must be mixed and deployed by strictly following measured quantities and procedures that are not common practice among drillers doing test borings.

Strength and Deformation

The general rule for grouting any kind of instrument in a borehole is to mimic the strength and deformation characteristics of the surrounding soil rather than the permeability. However, while it is feasible to match strengths, it is unfeasible with the same mix design to match the deformation modulus of cement-bentonite to that of a clay for example. The practical thing to do is to approximate the strength and minimize the area of the grouted annulus. In this way the grout column would only contribute a weak force in the situation where it might be an issue.

Strength data collected informally from various sources by the author over the years are summarized in Figure 1. A trend line drawn through the data points illustrates the decrease in strength with increasing water-cement ratio. The water-cement ratio controls the strength of the set grout (Marsland, 1973). Marsland's rule-of-thumb is to make the 7-day strength of the grout to match one quarter that of the surrounding soil.

Water and cement in proportions greater than about 0.7 to1.0 by weight will segregate without the addition of bentonite or some other type of filler material (clay or lime) to suspend the cement uniformly. In all cases sufficient filler is added to suspend the cement and to provide a thick-creamy-but-pumpable grout consistency. The bentonite does not add significant strength to the grout. The background data for Figure 1 also suggests the amount and type of bentonite or hydrated lime does not influence strength as long as the grout is non-bleeding and pumpable. If the grout bleeds the water-cement ratio decreases and strength increases. If fly ash were to be used as a substitute for cement the strength and modulus would be expected to drop. Fly ash contains less cementing agents (calcium and gypsum).

Grout Permeability

Permeability of the grout is mainly an issue that is limited to piezometer installations, and is the subject of a paper to be published in the near future. It is general practice to grout the borehole above a bentonite seal placed above the piezometer "intake zone" (sand that surrounds the piezometer), but the pa-

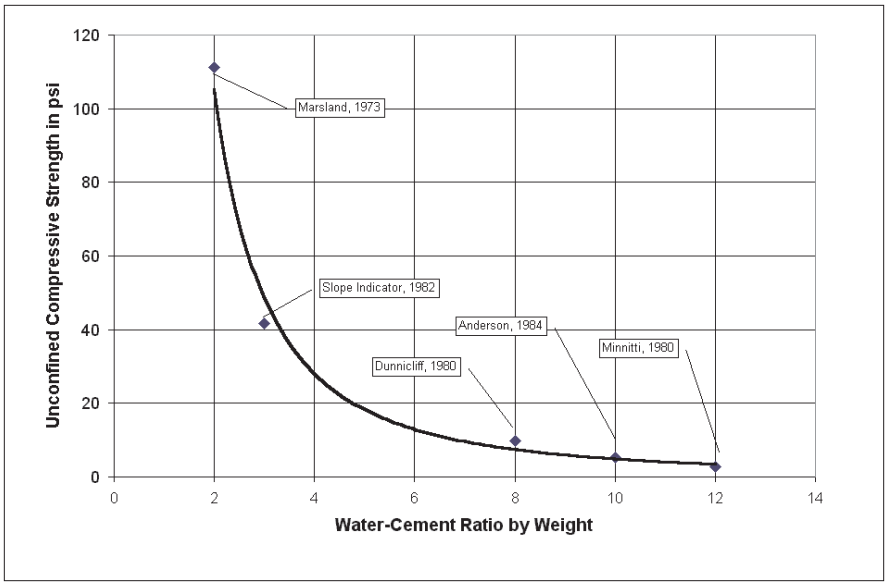

Figure 1. 28-day cement-bentonite grout strength vs. water-cement ratio. Data from author's personal files.

Table 1. Permeability, k, of some grouts			
Grout Type	**Characteristics**	**k (cm/sec)**	**Source**
Neat cement	w/c ratio = 0.89 to 0.53	10^{-5} to 10^{-7}	Baroid
Bentonite chips	hydrated	10^{-8}	Baroid
Bentonite slurry	6 % solids	10^{-5}	Baroid
Bentonite slurry	20 % solids	10^{-8}	Baroid
Cement-bentonite	water/solids = 4 to 1	10^{-6}	Vaughan, 1969
Cement-bentonite	w : c : b = 4 : 1 : 1	5 x 10^{-8}	Vaughan, 1973

per argues that boreholes may be fully-grouted for diaphragm piezometers, omitting both the sand and the bentonite seal. Two articles by Vaughan (1969 and 1973) make the point clear in theory and practice. This procedure not only simplifies difficult installation situations, but also improves the quality of the installation. It is really not a question of whether or not diaphragm piezometers work when fully surrounded with grout, but rather it is a question of making a grout with a suitable permeability. Cement-bentonite grout is generally well suited to accomplish this task.

The cement-bentonite fabric when set is an irregular honeycomb structure held together with both cured cement and colloidal bonds. It is a highly porous solid with a low permeability that lies somewhere in the cement and bentonite range, from $1x10^{-5}$ to $1x10^{-9}$ cm/sec. Typical published values of permeability are listed in Table 1. Vaughan (1973) quotes a coefficient of permeability for a pumpable cement-bentonite grout mix on the order of $5x10^{-8}$ cm/sec. For low bentonite solid contents the permeability can be expected to be close to $1x10^{-6}$ cm/sec and for higher bentonite solids content it would be close to $1x10^{-8}$ cm/sec. This is an area for further testing and research where the water-cement ratio, bentonite solids content and permeability should be established.

Typically used Bentonite

Drilling contractors in the US who do test borings in soil usually carry a high yielding sodium bentonite such as Supergel or Quik-Gel brands on their rigs. This is a finely ground, powered form of bentonite that yields as much drilling mud per sack as possible without additives. Other bentonite powder products have additives to enhance certain mud characteristics such as viscosity, density and filtration. Such additives are probably not detrimental to making a suitable cement-bentonite grout, but are not really relevant or cost effective in such a context. What seems not to be well understood is the feasibility of using coarser grains of bentonite to increase solids content for lowering the permeability in cement-bentonite grout. Would polymer additives be needed for mixing stability, for example?

As a side-note, sodium bentonite absorbs more water than calcium bentonite. According to clay mineralogists (Papp, 1996) the presence of sodium as the dominant exchangeable ion facilitates many interlamellar water layers to be absorbed into the crystalline structure, a phenomenon which does not occur with calcium or magnesium as dominant ions. Sodium bentonite is characterized as capable of absorbing at least five times its weight in water and expands when fully saturated with water to a volume 12 to 15 times its original dry size.

Sodium bentonite powder appears to be the most practicable and efficient to use in this context, but this does not mean that other fillers of different grain sizes and composition could not be used. It is matter of availability and convenience of a good product for this application. For example, in a 50-gallon batch of cement-lime grout, 150 pounds of hydrated lime can be replaced by using about 25 pounds of bentonite powder.

Mix Design Rules

In order to keep field procedures simple the emphasis should be on controlling the water-cement ratio. This is accomplished by mixing the cement with the water first. This is contrary to procedures used at more sophisticated grout plants for compaction grouting and sealing purposes. When water and cement are mixed first, the water-cement ratio stays fixed and the strength/modulus of the set grout is more predictable. If bentonite slurry is mixed first, the water-cement ratio cannot be controlled because the addition of cement must stop when the slurry thickens to a consistency that is still pumpable.

Making cement-bentonite grout in the field is a straightforward process. The most effective mixing is done in a barrel or tub with the drill-rig pump, cir-

Table 2. Cement-bentonite grout mixes				
Application	**Grout for Medium to Hard Soils**		**Grout for Soft Soils**	
Materials	Weight	Ratio by Weight	Weight	Ratio by Weight
Water	30 gallons	2.5	75 gallons	6.6
Portland Cement	94 lbs. (1 sack)	1	94 lbs. (1sack)	1
Bentonite	25 lbs. (as required)	0.3	39 lbs. (as required)	0.4
Notes	The 28-day compressive strength of this mix is about 50 psi, similar to very stiff to hard clay. The modulus is about 10,000 psi.		The 28-day strength of this mix is about 4 psi, similar to very soft clay.	

culating the batch through the pump in 50 to 200 gallon quantities. The rig pump provides the kind of jet-mixing required for getting the job done quickly. Any kind of bentonite powder used to make drilling mud combined with Type 1 Portland cement and water can be used, but the appropriate quantity of bentonite will vary somewhat depending on grade of bentonite, mixing sequence, mixing effort (agitation), water pH and temperature.

Grout mixes should be controlled by weight and proportioned to give the desired strength of the set grout. The conversion factors contained in Appendix H.10. in Dunnicliff (1988, 1993) are very helpful in mix design. Two mixes are given in Table 2 that varies in 28-day strength from 50 psi to 4 psi for water-cement ratios of 2.5 to 6.6 respectively.

The amount of bentonite that is required for the above mixing procedure would vary due to factors mentioned earlier. The amount of bentonite shown in Table 2 should only be used as a guide, but is also handy for estimating material quantities to be shipped to the site. With this method **more** bentonite is required than if water and bentonite were mixed first. This is an advantage from the standpoint of wanting a low permeability. When the bentonite solids content increases, the density increases and the permeability is lowered. A lower permeability is generally preferred since cement-bentonite grouts have a higher permeability than high-density bentonite grout or chip seals. Thus, another good reason for mixing water and cement before adding bentonite.

Old habits die hard, so that some users will insist on mixing water and bentonite powder first. This is normally the way drilling mud is mixed and it yields more slurry per sack of bentonite than the above method. Also, use of hydrated bentonite with cement added last is common practice in grouting technology for ground improvement. Such mixes are highly thixotropic and rely on industrial type mixing plants and methods. The cement content is difficult to control under ordinary borehole installation circumstances.

Mixing Procedure

A rig pump with one suction hose and a return hose fitted with a jet nozzle and a 50-gallon barrel, shown in Figure 2, are the minimum requirements for circulation batch mixing of grout. Paddle or high shear mixers can also be used. A measured quantity of clean water goes into the mixing tub/barrel first and the pumping and circulation starts. Then the cement is gradually added to the water and mixed thoroughly. At this stage the mix is like gray water. Next, bentonite powder is slowly added into the jetting area of the barrel, slowly enough so clumps of bentonite do not form. This should be constantly checked by scraping the bottom with a shovel. When clumps form, slow down and do not add any more powder until they are dissolved. Keep adding bentonite until the watery mix transitions to an oily/slimy consistency. Observe the consistency while mixing and let the grout thicken for another five to ten minutes. Generally, the mix thickens some more with added mixing time. Add more bentonite as required. When it is smooth and like thick cream or pancake batter, it is as heavy as is it feasible to pump. Drips of the grout should then barely come off a dipped finger and should form "craters" in the fluid surface. That is the correct consistency for pumping the grout batch down the tremie-pipe. When possible, withdraw the tremie after each batch an amount corresponding to the grout level in the boring to keep the pumping pressures as low as possible. When mixing grout 100 feet or more from the borehole, thinner consistency would be required, but at the risk of some bleeding.

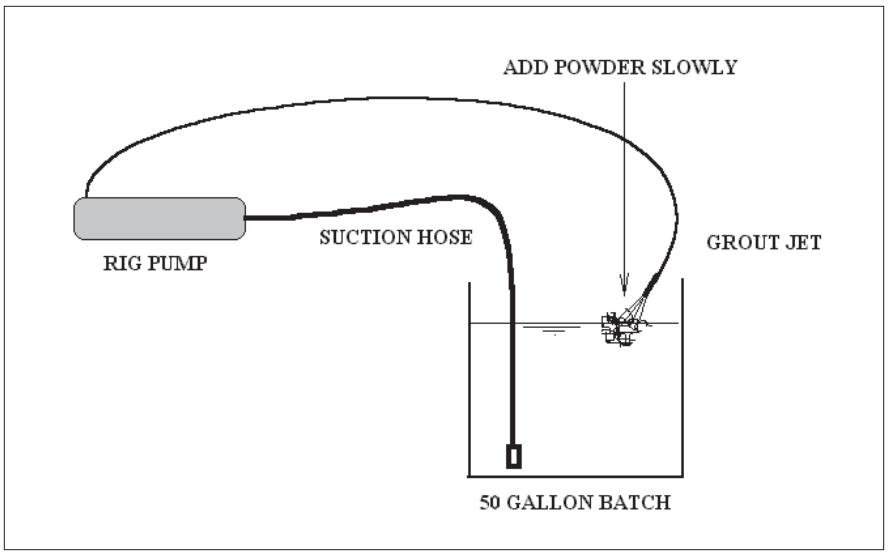

Figure 2. Circulation batch mixing of grout (minimum configuration). After mixing grout is tremied to bottom of the borehole.

Additional Considerations

Strength is often used to characterize a grout for deformation-type instruments, but modulus of deformation should ideally be the basis for judging compatibility with ground conditions. The grout column in a borehole will carry a total axial force smaller or greater than the material it replaced, according to its stiffness. When there is too much stiffness or force, displacements will be diminished and axial measurements can be less than displacements of the surrounding ground. Thus extra grout stiffness for extensometers is much more undesirable than for inclinometers, for example. More care should be taken in making a grout for axial borehole deformation measurements than for lateral deformation measurements.

Instrumentation installations often encounter the combination of both soft and hard ground in the same borehole. Obviously, staged grouting to match the required properties would be the ideal

procedure, but this is seldom warranted or practicable. Most of the design and installation challenge lies with deformation measurements in the axial direction of the borehole where large volumes of grout backfill must be placed. So, for extensometers, it is better to err on the softer side of the spectrum.

Lateral displacements of an inclinometer casing are generally unaffected by added grout stiffness. Where the grout column is too stiff the displacements will be distributed over a greater depth interval, but not be diminished in overall magnitude. The same is probably true if the grout is too soft, but there is the additional concern for lack of lateral confinement. Since inclinometer casings generally are under compression, lack of backfill or confinement can produce localized shifts in the borehole, masking smaller actual displacements. So, for inclinometers, it is better to err on the stiffer side of the spectrum.

It may not be possible to achieve a suitable grout with cement for softer clays. Fly ash promises to be a good substitute for reducing the modulus, but more testing is needed in this regard.

Conclusions

Grout backfill should ideally be selected according to the field instrument type being used and the given ground conditions. The reality however is that grouting practices will remain relatively crude and, at best, with only marginal control over the grout properties. Drillers, geologists and engineers alike still have a lot to learn about what is appropriate. We cannot just borrow ideas from drilling mud and grouting technology that have no relevance to what is needed for instrumentation functionality.

1. Avoid using a bentonite alone for a borehole grout. It is not a volumetrically stable material and can influence both piezometer and displacement measurements when it keeps hydrating or desiccating. It is often very difficult to place successfully.
2. A stable grout can be made using cement or fly ash with bentonite. Relatively small amounts of cement or fly ash are used as compared to grouts used for other geotechnical purposes such as compaction grouting and sealing of seepage. Grouting for instrumentation has different property priorities.
3. Grouting for field instrumentation should remain a relatively simple endeavor, using materials commonly available to drillers. However, when working in soils like normally consolidated clay, more attention should be paid to the mix design. Since little information is available on softer grouts, particularly those mixed with fly ash, a few trial batches in the laboratory are appropriate to determine basic characteristics for use on such projects.
4. Grout mixing should start with water and cement (or fly ash) first. Strength and modulus are more predictable that way. Also, and just as important, is that more bentonite solids can be added to the mix to lower permeability where required for sealing.
5. Grout permeability is an issue for piezometers installed in clay. The grout should have permeability no greater than one (possibly two) orders of magnitude above the clay to get representative readings.
6. Grout stability is very important during both the liquid and set conditions. The liquid grout consistency should be as thick as possible, yet liquid enough to be pumpable. This is a property that requires field experience. Field crews tend to err to the more liquid end of the spectrum, resulting in bleeding and possibly cracking when set.
7. Strength is often used to characterize a grout for deformation-type instruments, but modulus of deformation should ideally be the basis for judging compatibility with ground conditions. There is very little in the literature to help us select a grout mix for sealing piezometers in boreholes. Further testing and research is needed (see editor's note below).

Acknowledgements

The author acknowledges the technical contributions of Gordon E. Green and the editorial contributions by John Dunnicliff. They both gave a significant amount of their time to make this a more valuable and readable product.

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***Editor's Note**:*
John Dunnicliff, Erik Mikkelsen,and Allen Marr have decided to plan and conduct a test program to mix various proportions of cement and bentonite, also fly ash and bentonite, and test for strength, permeability, compressibility and volume stability. The results will be published in GIN as soon as they are available.

APPENDIX III

PROJECT TITLE: _____ PAGE: _____

SUBJECT: _____ JOB NO: _____

BY: _____ DATE: _____ CHECKED BY: _____ DATE: _____

EUSTIS
ENGINEERING L.L.C.
SINCE 1946

Piezometer Calibration Sheets

VW Piezometer Calibration Certificate

Serial #: 2303966
Range: 350 kPa
Cable Length: 15M
Date of Calibration: 04/22/2024

Part #: 52611028
Cable Part #: 50613824
Calibrated by: KR/NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-5.999410E-5	-1.481787E-1	8.097600E+2
psi	-8.701405E-6	-2.149150E-2	1.174456E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.122027E+2	-1.491565E-1	-2.072554E-1	-6.011760E-5	9.024351E-5	1.976628E-3
psi	1.177999E+2	-2.163331E-2	-3.005985E-2	-8.719317E-6	1.308871E-5	2.866855E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-1-10
depth: 10'
SIN: 2303966

Summary of Test Results at 15.0°C

Temperature Reading is 15.2°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2640.3	0.3	0.04	-0.07
35.0	5.08	2565.0	35.0	5.07	0.01
70.0	10.15	2487.9	69.8	10.12	0.06
105.0	15.23	2408.5	104.9	15.21	0.04
140.0	20.31	2327.5	139.9	20.29	0.02
175.0	25.38	2244.4	175.0	25.38	0.00
210.0	30.46	2159.4	210.0	30.46	-0.01
245.0	35.53	2072.0	245.1	35.56	-0.04
280.0	40.61	1982.5	280.2	40.65	-0.06
315.0	45.69	1891.0	315.1	45.70	-0.03
350.0	50.76	1797.1	349.7	50.73	0.07

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400197
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 09/18/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.100792E-4	3.062665E-2	8.253376E+2
psi	-1.596564E-5	4.442018E-3	1.197050E+2

Pressure in kPa/psi = $(A \times f^2) + (B \times f) + C$, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.274662E+2	2.685584E-2	1.322735E-1	-1.094148E-4	3.370766E-5	-5.110481E-4
psi	1.200138E+2	3.895109E-3	1.918464E-2	-1.586927E-5	4.888881E-6	-7.412123E-5

Pressure in kPa/psi = $C0 + (C1 \times f) + (C2 \times T) + (C3 \times f^2) + (C4 \times f \times T) + (C5 \times T^2)$

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-1-40
depth: 40'
SIN: 2400197

Summary of Test Results at 15.0°C

Temperature Reading is 14.9°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2880.7	0.1	0.01	-0.02
35.0	5.08	2822.2	35.0	5.07	0.00
70.0	10.15	2762.4	69.9	10.14	0.02
105.0	15.23	2701.1	104.9	15.22	0.02
140.0	20.31	2638.2	140.0	20.30	0.01
175.0	25.38	2573.7	175.0	25.38	-0.01
210.0	30.46	2507.5	210.0	30.46	-0.01
245.0	35.53	2439.3	245.0	35.54	-0.01
280.0	40.61	2369.1	280.0	40.62	-0.01
315.0	45.69	2296.8	315.0	45.69	-0.00
350.0	50.76	2221.9	349.9	50.76	0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400393
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 10/08/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.146241E-4	-1.982014E-3	7.922260E+2
psi	-1.662481E-5	-2.874667E-4	1.149026E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	7.910999E+2	-3.474464E-3	1.513067E-1	-1.144380E-4	4.282965E-5	-7.860029E-4
psi	1.147393E+2	-5.039281E-4	2.194517E-2	-1.659782E-5	6.211913E-6	-1.140000E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-1-80
Depth: 80'
S/N: 2400393

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2620.3	0.0	0.01	-0.01
35.0	5.08	2561.5	35.0	5.08	-0.01
70.0	10.15	2501.6	70.0	10.15	0.01
105.0	15.23	2440.1	104.9	15.21	0.03
140.0	20.31	2376.8	140.0	20.30	0.01
175.0	25.38	2311.9	175.0	25.38	-0.00
210.0	30.46	2245.1	210.0	30.46	-0.01
245.0	35.53	2176.2	245.1	35.54	-0.02
280.0	40.61	2105.2	280.0	40.62	-0.01
315.0	45.69	2031.8	315.0	45.69	-0.00
350.0	50.76	1955.7	349.9	50.76	0.02

VW Piezometer Calibration Certificate

Serial #: 2304361
Range: 700 kPa
Cable Length: 45M
Date of Calibration: 05/29/2024

Part #: 52611034
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.453734E-4	-9.765954E-2	1.559685E+3
psi	-2.108462E-5	-1.416431E-2	2.262130E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.560391E+3	-9.881472E-2	-6.802797E-3	-1.453680E-4	7.164742E-5	-1.958552E-3
psi	2.263155E+2	-1.433186E-2	-9.866619E-4	-2.108383E-5	1.039158E-5	-2.840638E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-1-100
depth: 100'
SIN: 2304361

Summary of Test Results at 15.0°C

Temperature Reading is 15.1°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2956.5	0.3	0.04	-0.04
70.0	10.15	2882.8	70.0	10.15	0.00
140.0	20.31	2807.3	139.8	20.28	0.03
210.0	30.46	2729.8	209.8	30.43	0.03
280.0	40.61	2650.2	279.8	40.58	0.03
350.0	50.76	2568.4	350.0	50.76	0.01
420.0	60.92	2483.9	420.1	60.94	-0.02
490.0	71.07	2397.1	490.2	71.10	-0.03
560.0	81.22	2307.6	560.2	81.25	-0.03
630.0	91.37	2215.0	630.1	91.38	-0.01
700.0	101.53	2119.3	699.7	101.49	0.04

VW Piezometer Calibration Certificate

Serial #: 2303971
Range: 350 kPa
Cable Length: 15M
Date of Calibration: 04/22/2024

Part #: 52611028
Cable Part #: 50613824
Calibrated by: KR/NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.132085E-4	-4.669274E-2	1.061321E+3
psi	-1.641950E-5	-6.772207E-3	1.539315E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.067778E+3	-5.031147E-2	-2.640069E-1	-1.129356E-4	1.196498E-4	1.622735E-3
psi	1.548683E+2	-7.297059E-3	-3.829096E-2	-1.637991E-5	1.735373E-5	2.353578E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-2-10
depth: 10'
SN: 2303971

Summary of Test Results at 15.0°C

Temperature Reading is 15.3°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2862.5	0.0	0.01	-0.01
35.0	5.08	2811.8	35.0	5.07	0.00
70.0	10.15	2760.1	70.0	10.15	0.00
105.0	15.23	2707.6	105.0	15.22	0.01
140.0	20.31	2654.0	140.0	20.30	0.01
175.0	25.38	2599.4	175.0	25.38	0.01
210.0	30.46	2543.7	210.0	30.46	-0.00
245.0	35.53	2486.8	245.1	35.54	-0.02
280.0	40.61	2429.0	280.0	40.62	-0.01
315.0	45.69	2369.6	315.0	45.69	-0.00
350.0	50.76	2308.9	350.0	50.76	0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400198
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 09/18/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-8.676774E-5	-1.728222E-2	8.731513E+2
psi	-1.258459E-5	-2.506574E-3	1.266398E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.736022E+2	-1.784281E-2	-5.824548E-2	-8.686292E-5	6.899392E-5	-7.106874E-4
psi	1.267052E+2	-2.587880E-3	-8.447789E-3	-1.259840E-5	1.000672E-5	-1.030765E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-2-40
depth: 40'
S/N: 2400198

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3074.2	-0.0	-0.00	0.00
35.0	5.08	3010.0	35.0	5.08	-0.01
70.0	10.15	2944.4	70.0	10.16	-0.01
105.0	15.23	2877.5	105.0	15.23	-0.00
140.0	20.31	2809.1	139.9	20.29	0.03
175.0	25.38	2738.9	174.9	25.37	0.02
210.0	30.46	2666.6	210.1	30.47	-0.02
245.0	35.53	2592.7	245.1	35.55	-0.02
280.0	40.61	2516.9	280.0	40.61	0.00
315.0	45.69	2438.7	315.0	45.68	0.01
350.0	50.76	2357.9	350.0	50.76	-0.00

DURHAM GEO SLOPE INDICATOR
VW Piezometer Calibration Certificate

Serial #: 2303833
Range: 350 kPa
Cable Length: 45M
Date of Calibration: 04/10/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-3.385914E-5	-1.868420E-1	8.735300E+2
psi	-4.910852E-6	-2.709913E-2	1.266948E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.759919E+2	-1.871598E-1	-2.140188E-1	-3.400120E-5	6.981207E-5	-7.651097E-4
psi	1.270518E+2	-2.714522E-2	-3.104079E-2	-4.931455E-6	1.012538E-5	-1.109697E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-2-80
depth: 80'
S/N: 2303833

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3021.3	-0.1	-0.01	0.01
35.0	5.08	2931.0	35.0	5.08	-0.01
70.0	10.15	2839.5	70.0	10.15	0.00
105.0	15.23	2746.4	105.0	15.23	0.00
140.0	20.31	2651.3	140.2	20.33	-0.04
175.0	25.38	2555.3	175.0	25.38	-0.00
210.0	30.46	2457.3	210.0	30.45	0.01
245.0	35.53	2357.4	244.9	35.52	0.02
280.0	40.61	2255.2	280.0	40.60	0.01
315.0	45.69	2151.0	315.0	45.69	0.00
350.0	50.76	2044.3	350.1	50.77	-0.02

VW Piezometer Calibration Certificate

Serial #: 2304364
Range: 700 kPa
Cable Length: 45M
Date of Calibration: 05/29/2024

Part #: 52611034
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.379123E-4	-1.327137E-1	1.498462E+3
psi	-2.000248E-5	-1.924849E-2	2.173378E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.497069E+3	-1.327288E-1	7.579258E-2	-1.380867E-4	5.239398E-5	-2.363286E-3
psi	2.171313E+2	-1.925068E-2	1.099278E-2	-2.002778E-5	7.599101E-6	-3.427655E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-2-100
depth: 100'
SIN: 2304364

Summary of Test Results at 15.0°C

Temperature Reading is 14.9°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2850.1	-0.1	-0.01	0.01
70.0	10.15	2772.6	70.4	10.21	-0.06
140.0	20.31	2694.2	139.9	20.30	0.01
210.0	30.46	2613.4	209.7	30.42	0.04
280.0	40.61	2530.2	279.8	40.58	0.03
350.0	50.76	2444.6	349.9	50.75	0.01
420.0	60.92	2356.4	420.0	60.92	-0.00
490.0	71.07	2265.3	490.2	71.09	-0.02
560.0	81.22	2171.1	560.2	81.25	-0.03
630.0	91.37	2073.8	630.2	91.40	-0.03
700.0	101.53	1973.1	699.7	101.48	0.04

VW Piezometer Calibration Certificate

Serial #: 2303972
Range: 350 kPa
Cable Length: 15M
Date of Calibration: 04/22/2024

Part #: 52611028
Cable Part #: 50613824
Calibrated by: KR/NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-8.274518E-5	-1.208053E-1	1.064714E+3
psi	-1.200117E-5	-1.752133E-2	1.544236E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.070700E+3	-1.234688E-1	-2.799663E-1	-8.260659E-5	1.045662E-4	5.715946E-4
psi	1.552919E+2	-1.790763E-2	-4.060566E-2	-1.198107E-5	1.516603E-5	8.290275E-5

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-3-10
depth: 10'
SN: 2303972

Summary of Test Results at 15.0°C

Temperature Reading is 15.2°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2930.5	0.0	0.00	-0.01
35.0	5.08	2872.4	35.0	5.08	-0.01
70.0	10.15	2813.2	70.0	10.15	0.01
105.0	15.23	2753.1	104.9	15.22	0.02
140.0	20.31	2691.7	140.0	20.31	-0.00
175.0	25.38	2629.3	175.0	25.38	-0.01
210.0	30.46	2565.8	210.0	30.46	-0.00
245.0	35.53	2500.9	245.0	35.54	-0.00
280.0	40.61	2434.9	280.0	40.61	-0.01
315.0	45.69	2367.4	315.0	45.69	0.00
350.0	50.76	2298.3	350.0	50.76	0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400199
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 09/18/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-8.506720E-5	-7.182685E-2	1.015613E+3
psi	-1.233795E-5	-1.041760E-2	1.473021E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.000488E+3	-6.637242E-2	6.484212E-1	-8.557979E-5	-8.533190E-5	-9.619686E-3
psi	1.451085E+2	-9.626502E-3	9.404550E-2	-1.241229E-5	-1.237634E-5	-1.395217E-3

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-3-40
depth: 40'
SIN: 2400199

Summary of Test Results at 15.0°C

Temperature Reading is 14.9°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3058.8	0.0	0.00	-0.01
35.0	5.08	2999.1	35.0	5.08	-0.01
70.0	10.15	2938.6	70.0	10.15	0.01
105.0	15.23	2876.8	105.0	15.22	0.01
140.0	20.31	2813.8	140.0	20.30	0.00
175.0	25.38	2749.8	174.9	25.37	0.03
210.0	30.46	2684.0	210.0	30.46	-0.00
245.0	35.53	2617.0	245.0	35.54	-0.01
280.0	40.61	2548.2	280.2	40.64	-0.06
315.0	45.69	2478.8	314.9	45.67	0.03
350.0	50.76	2406.8	350.0	50.76	0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2304089
Range: 350 kPa
Cable Length: 45 M
Date of Calibration: 04/29/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: KR
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.116228E-4	-2.487515E-2	1.055609E+3
psi	-1.618951E-5	-3.607834E-3	1.531031E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.060911E+3	-2.987968E-2	6.813704E-2	-1.108028E-4	3.623141E-5	-1.472381E-3
psi	1.538721E+2	-4.333680E-3	9.882439E-3	-1.607057E-5	5.254920E-6	-2.135507E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-3-80
depth: 80
SN: 2304089

Summary of Test Results at 15.0°C

Temperature Reading is 15.4°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2965.7	0.1	0.01	-0.02
35.0	5.08	2914.5	34.9	5.07	0.02
70.0	10.15	2862.2	70.0	10.15	0.00
105.0	15.23	2808.9	105.0	15.23	-0.00
140.0	20.31	2754.8	140.0	20.30	0.01
175.0	25.38	2699.6	175.0	25.38	0.01
210.0	30.46	2643.2	210.0	30.46	-0.00
245.0	35.53	2585.6	245.1	35.54	-0.02
280.0	40.61	2526.9	280.0	40.61	-0.00
315.0	45.69	2466.8	315.0	45.69	-0.00
350.0	50.76	2405.3	350.0	50.76	0.01

VW Piezometer Calibration Certificate

Serial #: 2304365
Range: 700 kPa
Cable Length: 45M
Date of Calibration: 05/29/2024

Part #: 52611034
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.756994E-4	-1.725024E-2	1.491703E+3
psi	-2.548303E-5	-2.501935E-3	2.163560E+2

Pressure in kPa/psi = $(A \times f^2) + (B \times f) + C$, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.490685E+3	-1.824813E-2	1.067190E-1	-1.756297E-4	4.932670E-5	-1.671120E-3
psi	2.162083E+2	-2.646666E-3	1.547827E-2	-2.547292E-5	7.154230E-6	-2.423754E-4

Pressure in kPa/psi = $C0 + (C1 \times f) + (C2 \times T) + (C3 \times f^2) + (C4 \times f \times T) + (C5 \times T^2)$

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGML
P-3-100
depth: 100'
SIN: 2304365

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2865.2	-0.1	-0.01	0.01
70.0	10.15	2795.8	70.2	10.18	-0.03
140.0	20.31	2725.1	140.0	20.30	0.00
210.0	30.46	2652.4	209.9	30.44	0.02
280.0	40.61	2577.7	279.9	40.59	0.01
350.0	50.76	2500.6	349.9	50.75	0.01
420.0	60.92	2421.1	420.1	60.92	-0.01
490.0	71.07	2339.0	490.1	71.09	-0.02
560.0	81.22	2254.1	560.1	81.24	-0.01
630.0	91.37	2166.0	630.0	91.38	-0.00
700.0	101.53	2074.4	699.9	101.51	0.02

VW Piezometer Calibration Certificate

Serial #: 2303973
Range: 350 kPa
Cable Length: 15M
Date of Calibration: 04/22/2024

Part #: 52611028
Cable Part #: 50613824
Calibrated by: KR/NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.017372E-4	1.450390E-2	8.961545E+2
psi	-1.475573E-5	2.103612E-3	1.305090E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.967670E+2	1.559465E-2	-2.506533E-1	-1.022753E-4	8.977561E-5	2.288628E-3
psi	1.305978E+2	2.261813E-3	-3.635417E-2	-1.483377E-5	1.302085E-5	3.319373E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-4-10
depth: 10'
SIN: 2303973

Summary of Test Results at 15.0°C

Temperature Reading is 15.2°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3045.9	0.1	0.02	-0.03
35.0	5.08	2987.7	35.0	5.08	-0.01
70.0	10.15	2928.4	69.9	10.13	0.04
105.0	15.23	2867.4	104.9	15.22	0.02
140.0	20.31	2805.1	140.0	20.30	0.00
175.0	25.38	2741.4	175.0	25.38	0.00
210.0	30.46	2676.0	210.1	30.47	-0.02
245.0	35.53	2609.2	245.1	35.55	-0.02
280.0	40.61	2540.6	280.0	40.61	-0.01
315.0	45.69	2469.9	315.0	45.69	0.00
350.0	50.76	2397.2	349.9	50.75	0.02

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400200
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 09/18/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-9.152749E-5	-9.532083E-3	6.229279E+2
psi	-1.327494E-5	-1.382511E-3	9.034802E+1

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	6.228816E+2	-1.114464E-2	5.386233E-2	-9.139446E-5	7.140345E-5	-9.522175E-4
psi	9.034131E+1	-1.616392E-3	7.812067E-3	-1.325564E-5	1.035619E-5	-1.381074E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-4-40'
depth: 40'
SIN: 2400200

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2557.1	0.1	0.01	-0.02
35.0	5.08	2482.9	35.0	5.08	-0.01
70.0	10.15	2406.5	69.9	10.14	0.02
105.0	15.23	2327.5	104.9	15.22	0.03
140.0	20.31	2245.5	140.0	20.31	-0.00
175.0	25.38	2160.7	175.0	25.39	-0.01
210.0	30.46	2072.6	210.0	30.46	-0.00
245.0	35.53	1980.6	245.0	35.54	-0.00
280.0	40.61	1884.2	280.0	40.62	-0.01
315.0	45.69	1782.7	315.0	45.69	-0.01
350.0	50.76	1675.7	349.9	50.75	0.02

VW Piezometer Calibration Certificate

Serial #: 2303837
Range: 350 kPa
Cable Length: 45M
Date of Calibration: 04/10/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-9.188675E-5	-7.219065E-2	1.053946E+3
psi	-1.332704E-5	-1.047036E-2	1.528619E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.053541E+3	-7.137707E-2	-1.459906E-1	-9.226153E-5	8.267147E-5	-9.228592E-4
psi	1.528032E+2	-1.035237E-2	-2.117414E-2	-1.338140E-5	1.199048E-5	-1.338494E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-4-80
depth: 80'
SIN: 2303837

Summary of Test Results at 15.0°C

Temperature Reading is 15.1°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3016.4	0.1	0.02	-0.03
35.0	5.08	2960.4	35.0	5.07	0.01
70.0	10.15	2903.2	69.9	10.14	0.03
105.0	15.23	2844.9	104.9	15.21	0.04
140.0	20.31	2785.3	140.0	20.31	-0.00
175.0	25.38	2724.8	175.1	25.39	-0.01
210.0	30.46	2663.0	210.1	30.47	-0.02
245.0	35.53	2600.1	245.0	35.54	-0.01
280.0	40.61	2535.8	280.0	40.61	-0.01
315.0	45.69	2470.1	315.0	45.69	0.00
350.0	50.76	2402.9	350.0	50.76	0.01

VW Piezometer Calibration Certificate

Serial #: 2304366
Range: 700 kPa
Cable Length: 45M
Date of Calibration: 05/29/2024

Part #: 52611034
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-2.041846E-4	1.541364E-2	1.617725E+3
psi	-2.961446E-5	2.235558E-3	2.346310E+2

Pressure in kPa/psi = (A x f^2) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.616452E+3	1.368367E-2	2.393754E-1	-2.039219E-4	2.822475E-5	-2.955096E-3
psi	2.344464E+2	1.984648E-3	3.471845E-2	-2.957636E-5	4.093653E-6	-4.286002E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f^2) + (C4 x f x T) + (C5 x T^2)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-4-100
depth: 100'
SIN: 2304366

Summary of Test Results at 15.0°C

Temperature Reading is 14.8°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2852.8	-0.0	-0.00	0.00
70.0	10.15	2791.4	69.7	10.11	0.04
140.0	20.31	2727.9	140.4	20.36	-0.05
210.0	30.46	2663.6	210.1	30.47	-0.01
280.0	40.61	2597.7	279.9	40.60	0.01
350.0	50.76	2529.8	349.9	50.75	0.01
420.0	60.92	2460.0	420.0	60.91	0.01
490.0	71.07	2388.2	489.9	71.06	0.01
560.0	81.22	2314.1	560.0	81.22	-0.00
630.0	91.37	2237.4	630.0	91.38	-0.01
700.0	101.53	2158.2	700.0	101.53	-0.00

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400201
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 09/18/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-8.675409E-5	-3.270350E-2	7.864934E+2
psi	-1.258261E-5	-4.743239E-3	1.140712E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	7.863401E+2	-3.296377E-2	-5.035921E-2	-8.690523E-5	6.769309E-5	-8.964850E-5
psi	1.140489E+2	-4.780989E-3	-7.303983E-3	-1.260453E-5	9.818049E-6	-1.300241E-5

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-5-10
depth: 10'
SIN: 2400201

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2828.2	0.1	0.01	-0.02
35.0	5.08	2760.8	35.0	5.07	0.01
70.0	10.15	2691.8	69.9	10.13	0.04
105.0	15.23	2620.6	105.0	15.23	-0.00
140.0	20.31	2547.6	140.1	20.32	-0.03
175.0	25.38	2473.0	175.1	25.39	-0.02
210.0	30.46	2396.3	210.0	30.45	0.01
245.0	35.53	2317.0	245.0	35.53	0.01
280.0	40.61	2235.2	280.0	40.61	0.01
315.0	45.69	2150.4	315.0	45.69	0.00
350.0	50.76	2062.5	350.0	50.77	-0.00

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400394
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 10/08/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-9.019141E-5	-7.720606E-2	8.657465E+2
psi	-1.308115E-5	-1.119779E-2	1.255659E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.644382E+2	-7.883906E-2	1.693102E-1	-8.999995E-5	5.087105E-5	-1.051537E-3
psi	1.253761E+2	-1.143463E-2	2.455636E-2	-1.305338E-5	7.378219E-6	-1.525126E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-5-40
depth: 40'
SIN: 2400394

Summary of Test Results at 15.0°C

Temperature Reading is 14.9°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2699.5	0.1	0.01	-0.02
35.0	5.08	2637.0	35.0	5.08	-0.00
70.0	10.15	2573.1	70.0	10.15	0.01
105.0	15.23	2507.8	104.9	15.21	0.03
140.0	20.31	2440.8	140.0	20.30	0.01
175.0	25.38	2372.3	175.0	25.38	-0.00
210.0	30.46	2302.2	210.0	30.46	-0.00
245.0	35.53	2230.0	245.1	35.54	-0.02
280.0	40.61	2155.9	280.1	40.62	-0.02
315.0	45.69	2079.8	315.0	45.69	-0.01
350.0	50.76	2001.5	349.9	50.75	0.03

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2304087
Range: 350 kPa
Cable Length: 45 M
Date of Calibration: 04/29/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: KR
Note:

ABC Calibration Factors

	A	B	C
kPa	-5.073395E-5	-1.178360E-1	7.630905E+2
psi	-7.358335E-6	-1.709066E-2	1.106769E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	7.643726E+2	-1.189389E-1	-6.344183E-2	-5.072099E-5	6.757167E-5	-9.678664E-4
psi	1.108628E+2	-1.725062E-2	-9.201456E-3	-7.356455E-6	9.800438E-6	-1.403771E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-5-80
depth: 60'
SIN: 2304087

Summary of Test Results at 15.0°C

Temperature Reading is 15.4°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2886.9	0.1	0.01	-0.03
35.0	5.08	2801.1	34.9	5.07	0.01
70.0	10.15	2713.0	70.0	10.15	0.01
105.0	15.23	2623.0	105.0	15.22	0.01
140.0	20.31	2530.7	140.0	20.30	0.01
175.0	25.38	2436.1	174.9	25.37	0.01
210.0	30.46	2338.7	210.0	30.46	-0.01
245.0	35.53	2238.6	245.1	35.54	-0.02
280.0	40.61	2135.5	280.1	40.62	-0.03
315.0	45.69	2029.3	315.0	45.69	-0.01
350.0	50.76	1919.7	349.9	50.75	0.03

VW Piezometer Calibration Certificate

Serial #: 2304367
Range: 700 kPa
Cable Length: 45M
Date of Calibration: 05/30/2024

Part #: 52611034
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.442347E-4	-4.573559E-2	1.528290E+3
psi	-2.091947E-5	-6.633383E-3	2.216597E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.528787E+3	-4.605914E-2	-2.580740E-2	-1.443182E-4	4.574516E-5	-2.107398E-3
psi	2.217317E+2	-6.680311E-3	-3.743045E-3	-2.093157E-5	6.634772E-6	-3.056521E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-6-100
depth: 100'
SIN: 2304367

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3100.4	0.0	0.00	-0.00
70.0	10.15	3025.2	69.9	10.14	0.01
140.0	20.31	2947.8	140.2	20.34	-0.03
210.0	30.46	2869.0	209.9	30.45	0.01
280.0	40.61	2787.8	279.9	40.60	0.01
350.0	50.76	2704.1	350.0	50.76	0.00
420.0	60.92	2618.0	420.0	60.91	0.01
490.0	71.07	2529.1	490.0	71.07	-0.01
560.0	81.22	2437.1	560.1	81.23	-0.01
630.0	91.37	2342.1	630.0	91.38	-0.00
700.0	101.53	2243.1	699.9	101.52	0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400387
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 10/09/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-8.343687E-5	-1.173109E-1	1.136514E+3
psi	-1.210149E-5	-1.701451E-2	1.648374E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.140477E+3	-1.202076E-1	-8.619906E-2	-8.310100E-5	7.377338E-5	-1.304408E-3
psi	1.654121E+2	-1.743463E-2	-1.250211E-2	-1.205278E-5	1.069992E-5	-1.891882E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-6-10
depth: 10'
SIN: 2400387

Summary of Test Results at 15.0°C

Temperature Reading is 14.9°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3054.0	0.0	0.01	-0.01
35.0	5.08	2997.7	35.1	5.09	-0.02
70.0	10.15	2940.7	70.0	10.15	0.01
105.0	15.23	2882.9	104.9	15.21	0.03
140.0	20.31	2824.0	139.8	20.28	0.05
175.0	25.38	2763.9	174.9	25.37	0.03
210.0	30.46	2702.5	210.1	30.47	-0.03
245.0	35.53	2640.0	245.3	35.58	-0.08
280.0	40.61	2576.8	280.2	40.64	-0.05
315.0	45.69	2513.2	314.7	45.64	0.10
350.0	50.76	2446.6	350.0	50.77	-0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400395
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 10/08/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.093358E-4	-1.105016E-1	1.179890E+3
psi	-1.585780E-5	-1.602689E-2	1.711284E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.177875E+3	-1.104278E-1	-2.173971E-2	-1.096334E-4	1.067766E-4	2.243918E-4
psi	1.708363E+2	-1.601619E-2	-3.153076E-3	-1.590098E-5	1.548664E-5	3.254527E-5

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x T²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-6-40
depth: 40'
S/N: 2400395

Summary of Test Results at 15.0°C

Temperature Reading is 14.8°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2817.9	0.3	0.04	-0.08
35.0	5.08	2769.9	35.0	5.07	0.01
70.0	10.15	2721.0	69.7	10.11	0.08
105.0	15.23	2671.0	104.7	15.18	0.09
140.0	20.31	2619.8	140.0	20.30	0.01
175.0	25.38	2567.9	175.2	25.41	-0.05
210.0	30.46	2515.4	210.2	30.48	-0.05
245.0	35.53	2461.9	245.2	35.56	-0.04
280.0	40.61	2407.7	280.0	40.61	-0.01
315.0	45.69	2352.4	314.9	45.68	0.02
350.0	50.76	2295.8	349.9	50.75	0.02

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2304088
Range: 350 kPa
Cable Length: 45 M
Date of Calibration: 04/29/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: KR
Note:

ABC Calibration Factors

	A	B	C
kPa	-8.768629E-5	1.032869E-2	8.077613E+2
psi	-1.271782E-5	1.498050E-3	1.171558E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	8.084472E+2	8.581855E-3	6.284784E-2	-8.751016E-5	5.136689E-5	-1.549056E-3
psi	1.172553E+2	1.244692E-3	9.115305E-3	-1.269227E-5	7.450134E-6	-2.246714E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-6-80
depth: 80'
SIN: 2304088

Summary of Test Results at 15.0°C

Temperature Reading is 15.4°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3094.5	0.1	0.01	-0.01
35.0	5.08	3028.2	35.0	5.07	0.01
70.0	10.15	2960.1	70.0	10.15	0.00
105.0	15.23	2890.5	105.0	15.23	0.00
140.0	20.31	2819.3	139.9	20.29	0.02
175.0	25.38	2745.9	175.0	25.38	0.01
210.0	30.46	2670.4	210.0	30.46	-0.01
245.0	35.53	2592.8	245.0	35.54	-0.01
280.0	40.61	2512.8	280.1	40.62	-0.02
315.0	45.69	2430.3	315.0	45.68	0.01
350.0	50.76	2344.6	350.0	50.76	0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2303835
Range: 350 kPa
Cable Length: 45M
Date of Calibration: 04/10/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-6.918289E-5	-1.226370E-1	1.012585E+3
psi	-1.003413E-5	-1.778699E-2	1.468630E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.014899E+3	-1.235843E-1	-1.653672E-1	-6.924319E-5	8.257421E-5	-8.124271E-4
psi	1.471986E+2	-1.792438E-2	-2.398448E-2	-1.004287E-5	1.197637E-5	-1.178325E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-6-100
depth: 100'
SIN: 2303835

Summary of Test Results at 15.0°C

Temperature Reading is 15.2°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3040.3	0.2	0.03	-0.07
35.0	5.08	2976.0	34.9	5.06	0.02
70.0	10.15	2910.4	69.7	10.11	0.09
105.0	15.23	2842.9	104.8	15.20	0.06
140.0	20.31	2773.4	140.3	20.35	-0.09
175.0	25.38	2704.1	175.1	25.39	-0.02
210.0	30.46	2633.1	210.0	30.46	-0.00
245.0	35.53	2560.5	245.0	35.53	0.00
280.0	40.61	2486.4	280.0	40.61	0.01
315.0	45.69	2410.5	315.0	45.69	0.00
350.0	50.76	2332.9	350.0	50.76	0.01

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400392
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 10/08/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.312332E-4	5.365806E-2	1.032934E+3
psi	-1.903376E-5	7.782441E-3	1.498143E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.029239E+3	5.505821E-2	7.648588E-2	-1.316465E-4	4.798133E-5	-5.424045E-4
psi	1.492785E+2	7.985515E-3	1.109334E-2	-1.909371E-5	6.959101E-6	-7.866909E-5

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-7-10
depth: 10'
SIN: 2400392

Summary of Test Results at 15.0°C

Temperature Reading is 14.9°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3017.3	0.0	0.01	-0.01
35.0	5.08	2969.6	35.0	5.08	0.00
70.0	10.15	2920.8	70.1	10.17	-0.03
105.0	15.23	2871.4	105.0	15.23	0.00
140.0	20.31	2821.2	139.8	20.28	0.05
175.0	25.38	2769.8	174.8	25.35	0.07
210.0	30.46	2717.0	210.0	30.45	0.01
245.0	35.53	2662.8	245.3	35.58	-0.08
280.0	40.61	2608.1	280.2	40.64	-0.05
315.0	45.69	2552.3	315.0	45.69	-0.00
350.0	50.76	2495.1	349.8	50.74	0.05

DURHAM GEO SLOPE INDICATOR

VW Piezometer Calibration Certificate

Serial #: 2400396
Range: 350 kPa
Cable Length: 30M
Date of Calibration: 10/08/2024

Part #: 52611024
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-1.233761E-4	-8.258195E-2	1.130768E+3
psi	-1.789418E-5	-1.197750E-2	1.640040E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	1.129206E+3	-8.292829E-2	4.586258E-2	-1.235814E-4	8.970887E-5	-1.262863E-3
psi	1.637774E+2	-1.202773E-2	6.651803E-3	-1.792397E-5	1.301117E-5	-1.831627E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-7-40
depth: 40'
SIN: 2400396

Summary of Test Results at 15.0°C

Temperature Reading is 14.8°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2711.1	0.1	0.01	-0.03
35.0	5.08	2664.1	35.1	5.09	-0.03
70.0	10.15	2616.5	70.0	10.16	-0.01
105.0	15.23	2568.4	104.8	15.20	0.05
140.0	20.31	2519.3	139.7	20.25	0.10
175.0	25.38	2468.7	175.0	25.38	0.01
210.0	30.46	2417.2	210.3	30.50	-0.08
245.0	35.53	2365.3	245.2	35.56	-0.05
280.0	40.61	2312.4	280.1	40.62	-0.03
315.0	45.69	2258.4	315.0	45.69	0.00
350.0	50.76	2203.4	349.8	50.74	0.05

VW Piezometer Calibration Certificate

Serial #: 2304084
Range: 350 kPa
Cable Length: 45 M
Date of Calibration: 04/29/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: KR
Note:

ABC Calibration Factors

	A	B	C
kPa	-7.598533E-5	-1.001542E-1	9.588130E+2
psi	-1.102074E-5	-1.452613E-2	1.365290E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	9.599147E+2	-1.003053E-1	-1.347219E-1	-7.615683E-5	6.419665E-5	-1.248471E-4
psi	1.366928E+2	-1.454804E-2	-1.953975E-2	-1.104561E-5	9.310933E-6	-1.810753E-5

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-7-80
depth: 80
SIN: 2304084

Summary of Test Results at 15.0°C

Temperature Reading is 15.2°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	2921.7	0.1	0.01	-0.02
35.0	5.08	2856.9	35.0	5.07	0.01
70.0	10.15	2791.0	69.9	10.14	0.02
105.0	15.23	2723.5	105.0	15.22	0.01
140.0	20.31	2654.4	140.0	20.31	-0.01
175.0	25.38	2584.4	175.0	25.38	-0.00
210.0	30.46	2512.5	210.0	30.46	-0.00
245.0	35.53	2439.0	245.0	35.54	-0.01
280.0	40.61	2363.8	280.0	40.61	-0.00
315.0	45.69	2286.8	315.0	45.68	0.01
350.0	50.76	2207.5	350.0	50.76	0.00

VW Piezometer Calibration Certificate

Serial #: 2304090
Range: 350 kPa
Cable Length: 45M
Date of Calibration: 04/30/2024

Part #: 52611027
Cable Part #: 50613824
Calibrated by: NB
Note:

ABC Calibration Factors

	A	B	C
kPa	-6.381543E-5	-1.191881E-1	9.598982E+2
psi	-9.255642E-6	-1.728677E-2	1.404914E+2

Pressure in kPa/psi = (A x f²) + (B x f) + C, where f is frequency in Hertz.

TI Calibration Factors

	C0	C1	C2	C3	C4	C5
kPa	9.610262E+2	-1.198280E-1	-6.160081E-2	-6.386888E-5	6.526763E-5	-3.222670E-3
psi	1.406550E+2	-1.737957E-2	-8.934439E-3	-9.263395E-6	9.466266E-6	-4.674086E-4

Pressure in kPa/psi = C0 + (C1 x f) + (C2 x T) + (C3 x f²) + (C4 x f x T) + (C5 x T²)

Where f is the frequency in Hertz and T is the Temperature in °C.
TI factors are calculated from temperatures at 5.0, 15.0, and 25.0 °C.
Applied pressure and temperature are NIST traceable.

24717.03 TGMC
P-7-100
depth: 100'
SN: 2304090

Summary of Test Results at 15.0°C

Temperature Reading is 15.0°C
Applied Pressure is referenced to 1 atm. Calculated Pressure uses ABC Calibration factors.

Applied (kPa)	Equivalent (psi)	Frequency (Hz)	Calculated (kPa)	Calculated (psi)	Error (%FS)
0.0	0.00	3072.5	-0.0	-0.00	0.00
35.0	5.08	3003.6	35.0	5.07	0.01
70.0	10.15	2933.2	70.0	10.15	0.01
105.0	15.23	2861.5	105.1	15.24	-0.02
140.0	20.31	2788.5	140.1	20.32	-0.02
175.0	25.38	2714.1	175.0	25.39	-0.01
210.0	30.46	2638.4	210.0	30.45	0.01
245.0	35.53	2560.8	244.9	35.53	0.02
280.0	40.61	2481.5	279.9	40.60	0.02
315.0	45.69	2400.2	315.0	45.68	0.01
350.0	50.76	2316.6	350.1	50.77	-0.02

PROJECT TITLE: _____ PAGE: _____

SUBJECT: _____ JOB NO: _____

BY: _____ DATE: _____ CHECKED BY: _____ DATE: _____

EUSTIS
ENGINEERING L.L.C.
SINCE 1946

V-Logger Data Logger Calibration Sheets

DURHAM GEO SLOPE INDICATOR

Calibration Record

V-Logger

DGSI
DURHAM GEO SLOPE INDICATOR

Part Number: 52615140 Serial Number: 2430819

Specification

Frequency Accuracy: ± **(0.002% of Reading +0.04Hz)**
Temperature Accuracy: ± **.5 °C**

Frequency Generator

Calibration Standard: Agilent 33210A Serial Number: 20-78-SI
Calibrator Re-Certification Due: July 6, 2024

Temperature Resistance

Calibration Standard: DGSI Resistance Box Serial Number: 20-14-SI
Calibrator Re-Certification Due: July 6, 2024

	INPUT (Hz)	*ACCEPTABLE RESPONSE (Hz)*	*ACTUAL RESPONSE (Hz)*
FREQUENCY	450.000	449.951 to 450.049	449.998
	1000.000	999.940 to 1000.060	999.996
	2000.000	1999.920 to 2000.080	1999.993
	3000.000	2999.900 to 3000.100	2999.988
	4000.000	3999.880 to 4000.120	3999.985
	5000.000	4999.860 to 5000.140	4999.986
	6000.000	5999.840 to 6000.160	5999.978

	INPUT (Ω)	*IDEAL RESPONSE (°C)*	*ACCEPTABLE RESPONSE (°C)*	*ACTUAL RESPONSE (°C)*
TEMPERATURE RTD	1715	-20.0	-20.5 to -19.5	-19.9
	2076	30.0	29.5 to 30.5	30.2
	2482	80.0	79.5 to 80.5	80.2
THERMISTOR	29142	-20.0	-20.5 to -19.5	-20.0
	2416	30.0	29.5 to 30.5	29.9
	377	80.0	79.5 to 80.5	80.0

This Certificate confirms that the equipment listed above has been calibrated in accordance with the manufacturer's specifications with calibration standards that are traceable to the National Institute of Standards and Technology (NIST).

Calibrated By: RP Date: 10-Oct-24

P-1
SIN: 2430819

4561 Greer Circle, Suite 100, Tucker, GA 30083, USA
www.durhamgeo.com www.slopeindicator.com

DURHAM GEO SLOPE INDICATOR

Calibration Record

V-Logger

DGSI
DURHAM GEO SLOPE INDICATOR

Part Number: 52615140 Serial Number: 2430821

Specification

Frequency Accuracy: ± **(0.002% of Reading +0.04Hz)**
Temperature Accuracy: ± **.5 °C**

Frequency Generator

Calibration Standard: Agilent 33210A Serial Number: 20-78-SI
Calibrator Re-Certification Due: July 6, 2024

Temperature Resistance

Calibration Standard: DGSI Resistance Box Serial Number: 20-14-SI
Calibrator Re-Certification Due: July 6, 2024

	INPUT (Hz)	*ACCEPTABLE RESPONSE (Hz)*	*ACTUAL RESPONSE (Hz)*
FREQUENCY	450.000	449.951 to 450.049	449.997
	1000.000	999.940 to 1000.060	999.995
	2000.000	1999.920 to 2000.080	1999.991
	3000.000	2999.900 to 3000.100	2999.988
	4000.000	3999.880 to 4000.120	3999.984
	5000.000	4999.860 to 5000.140	4999.982
	6000.000	5999.840 to 6000.160	5999.978

	INPUT (Ω)	*IDEAL RESPONSE (°C)*	*ACCEPTABLE RESPONSE (°C)*	*ACTUAL RESPONSE (°C)*
TEMPERATURE RTD	1715	-20.0	-20.5 to -19.5	-19.9
	2076	30.0	29.5 to 30.5	30.2
	2482	80.0	79.5 to 80.5	80.2
THERMISTOR	29142	-20.0	-20.5 to -19.5	-20.0
	2416	30.0	29.5 to 30.5	29.9
	377	80.0	79.5 to 80.5	80.0

This Certificate confirms that the equipment listed above has been calibrated in accordance with the manufacturer's specifications with calibration standards that are traceable to the National Institute of Standards and Technology (NIST).

Calibrated By: RP Date: 10-Oct-24

P-2

S/N: 2430821

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DURHAM GEO SLOPE INDICATOR

Calibration Record

V-Logger

DGSI
DURHAM GEO SLOPE INDICATOR

Part Number: 52615140 Serial Number: 2430818

Specification

Frequency Accuracy: ± **(0.002% of Reading +0.04Hz)**
Temperature Accuracy: ± **.5 °C**

Frequency Generator

Calibration Standard: Agilent 33210A Serial Number: 20-78-SI
Calibrator Re-Certification Due: July 6, 2024

Temperature Resistance

Calibration Standard: DGSI Resistance Box Serial Number: 20-14-SI
Calibrator Re-Certification Due: July 6, 2024

	INPUT (Hz)	*ACCEPTABLE RESPONSE (Hz)*	*ACTUAL RESPONSE (Hz)*
FREQUENCY	450.000	449.951 to 450.049	449.996
	1000.000	999.940 to 1000.060	999.996
	2000.000	1999.920 to 2000.080	1999.993
	3000.000	2999.900 to 3000.100	2999.989
	4000.000	3999.880 to 4000.120	3999.988
	5000.000	4999.860 to 5000.140	4999.984
	6000.000	5999.840 to 6000.160	5999.977

	INPUT (Ω)	*IDEAL RESPONSE (°C)*	*ACCEPTABLE RESPONSE (°C)*	*ACTUAL RESPONSE (°C)*
TEMPERATURE RTD	1715	-20.0	-20.5 to -19.5	-19.9
	2076	30.0	29.5 to 30.5	30.3
	2482	80.0	79.5 to 80.5	80.2
THERMISTOR	29142	-20.0	-20.5 to -19.5	-20.0
	2416	30.0	29.5 to 30.5	29.9
	377	80.0	79.5 to 80.5	80.0

This Certificate confirms that the equipment listed above has been calibrated in accordance with the manufacturer's specifications with calibration standards that are traceable to the National Institute of Standards and Technology (NIST).

Calibrated By: RP Date: 10-Oct-24

P-3
S/N: 2430818

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DURHAM GEO SLOPE INDICATOR

Calibration Record

V-Logger

DGSI
DURHAM GEO SLOPE INDICATOR

Part Number: 52615140 Serial Number: 2430822

Specification

Frequency Accuracy: ± **(0.002% of Reading +0.04Hz)**
Temperature Accuracy: ± **.5 °C**

Frequency Generator

Calibration Standard: Agilent 33210A Serial Number: 20-78-SI
Calibrator Re-Certification Due: July 6, 2024

Temperature Resistance

Calibration Standard: DGSI Resistance Box Serial Number: 20-14-SI
Calibrator Re-Certification Due: July 6, 2024

	INPUT (Hz)	*ACCEPTABLE RESPONSE (Hz)*	*ACTUAL RESPONSE (Hz)*
FREQUENCY	450.000	449.951 to 450.049	449.997
	1000.000	999.940 to 1000.060	999.994
	2000.000	1999.920 to 2000.080	1999.992
	3000.000	2999.900 to 3000.100	2999.991
	4000.000	3999.880 to 4000.120	3999.988
	5000.000	4999.860 to 5000.140	4999.987
	6000.000	5999.840 to 6000.160	5999.986

	INPUT (Ω)	*IDEAL RESPONSE (°C)*	*ACCEPTABLE RESPONSE (°C)*	*ACTUAL RESPONSE (°C)*
TEMPERATURE RTD	1715	-20.0	-20.5 to -19.5	-19.9
	2076	30.0	29.5 to 30.5	30.2
	2482	80.0	79.5 to 80.5	80.2
THERMISTOR	29142	-20.0	-20.5 to -19.5	-20.0
	2416	30.0	29.5 to 30.5	29.9
	377	80.0	79.5 to 80.5	80.0

This Certificate confirms that the equipment listed above has been calibrated in accordance with the manufacturer's specifications with calibration standards that are traceable to the National Institute of Standards and Technology (NIST).

Calibrated By: RP Date: 11-Oct-24

P-4
SIN: 2430822

4561 Greer Circle, Suite 100, Tucker, GA 30083, USA
www.durhamgeo.com www.slopeindicator.com

DURHAM GEO SLOPE INDICATOR

Calibration Record

V-Logger

DGSI
DURHAM GEO SLOPE INDICATOR

Part Number: 52615140 Serial Number: 2430824

Specification

Frequency Accuracy: ± **(0.002% of Reading +0.04Hz)**
Temperature Accuracy: ± **.5 °C**

Frequency Generator

Calibration Standard: Agilent 33210A Serial Number: 20-78-SI
Calibrator Re-Certification Due: July 6, 2024

Temperature Resistance

Calibration Standard: DGSI Resistance Box Serial Number: 20-14-SI
Calibrator Re-Certification Due: July 6, 2024

	INPUT (Hz)	*ACCEPTABLE RESPONSE (Hz)*	*ACTUAL RESPONSE (Hz)*
FREQUENCY	450.000	449.951 to 450.049	449.963
	1000.000	999.940 to 1000.060	999.982
	2000.000	1999.920 to 2000.080	1999.976
	3000.000	2999.900 to 3000.100	2999.986
	4000.000	3999.880 to 4000.120	3999.977
	5000.000	4999.860 to 5000.140	4999.989
	6000.000	5999.840 to 6000.160	5999.977

	INPUT (Ω)	*IDEAL RESPONSE (°C)*	*ACCEPTABLE RESPONSE (°C)*	*ACTUAL RESPONSE (°C)*
TEMPERATURE RTD	1715	-20.0	-20.5 to -19.5	-19.9
	2076	30.0	29.5 to 30.5	30.2
	2482	80.0	79.5 to 80.5	80.2
THERMISTOR	29142	-20.0	-20.5 to -19.5	-20.0
	2416	30.0	29.5 to 30.5	29.9
	377	80.0	79.5 to 80.5	80.0

This Certificate confirms that the equipment listed above has been calibrated in accordance with the manufacturer's specifications with calibration standards that are traceable to the National Institute of Standards and Technology (NIST).

Calibrated By: RP Date: 11-Oct-24

P-5
S/N: 2430824

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DURHAM GEO SLOPE INDICATOR

Calibration Record

V-Logger

DGSI
DURHAM GEO SLOPE INDICATOR

Part Number: 52615140 Serial Number: 2430823

Specification

Frequency Accuracy: ± **(0.002% of Reading +0.04Hz)**
Temperature Accuracy: ± **.5 °C**

Frequency Generator

Calibration Standard: Agilent 33210A Serial Number: 20-78-SI
Calibrator Re-Certification Due: July 6, 2024

Temperature Resistance

Calibration Standard: DGSI Resistance Box Serial Number: 20-14-SI
Calibrator Re-Certification Due: July 6, 2024

	INPUT (Hz)	*ACCEPTABLE RESPONSE (Hz)*	*ACTUAL RESPONSE (Hz)*
FREQUENCY	450.000	449.951 to 450.049	449.998
	1000.000	999.940 to 1000.060	999.996
	2000.000	1999.920 to 2000.080	1999.992
	3000.000	2999.900 to 3000.100	2999.986
	4000.000	3999.880 to 4000.120	3999.984
	5000.000	4999.860 to 5000.140	4999.986
	6000.000	5999.840 to 6000.160	5999.981

	INPUT (Ω)	*IDEAL RESPONSE (°C)*	*ACCEPTABLE RESPONSE (°C)*	*ACTUAL RESPONSE (°C)*
TEMPERATURE RTD	1715	-20.0	-20.5 to -19.5	-19.9
	2076	30.0	29.5 to 30.5	30.2
	2482	80.0	79.5 to 80.5	80.2
THERMISTOR	29142	-20.0	-20.5 to -19.5	-20.0
	2416	30.0	29.5 to 30.5	29.9
	377	80.0	79.5 to 80.5	80.0

This Certificate confirms that the equipment listed above has been calibrated in accordance with the manufacturer's specifications with calibration standards that are traceable to the National Institute of Standards and Technology (NIST).

Calibrated By: RP Date: 11-Oct-24

P-6

S/N: 2430823

4561 Greer Circle, Suite 100, Tucker, GA 30083, USA
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DURHAM GEO SLOPE INDICATOR

Calibration Record

V-Logger

DGSI
DURHAM GEO SLOPE INDICATOR

Part Number: 52615140 Serial Number: 2430820

Specification

Frequency Accuracy: ± **(0.002% of Reading +0.04Hz)**
Temperature Accuracy: ± **.5 °C**

Frequency Generator

Calibration Standard: Agilent 33210A Serial Number: 20-78-SI
Calibrator Re-Certification Due: July 6, 2024

Temperature Resistance

Calibration Standard: DGSI Resistance Box Serial Number: 20-14-SI
Calibrator Re-Certification Due: July 6, 2024

	INPUT (Hz)	*ACCEPTABLE RESPONSE (Hz)*	*ACTUAL RESPONSE (Hz)*
FREQUENCY	450.000	449.951 to 450.049	449.997
	1000.000	999.940 to 1000.060	999.993
	2000.000	1999.920 to 2000.080	1999.992
	3000.000	2999.900 to 3000.100	2999.986
	4000.000	3999.880 to 4000.120	3999.984
	5000.000	4999.860 to 5000.140	4999.983
	6000.000	5999.840 to 6000.160	5999.977

	INPUT (Ω)	*IDEAL RESPONSE (°C)*	*ACCEPTABLE RESPONSE (°C)*	*ACTUAL RESPONSE (°C)*
TEMPERATURE RTD	1715	-20.0	-20.5 to -19.5	-19.9
	2076	30.0	29.5 to 30.5	30.2
	2482	80.0	79.5 to 80.5	80.0
THERMISTOR	29142	-20.0	-20.5 to -19.5	-20.0
	2416	30.0	29.5 to 30.5	29.9
	377	80.0	79.5 to 80.5	80.0

This Certificate confirms that the equipment listed above has been calibrated in accordance with the manufacturer's specifications with calibration standards that are traceable to the National Institute of Standards and Technology (NIST).

Calibrated By: RP Date: 10-Oct-24

P-7

SIN: 2430820

4561 Greer Circle, Suite 100, Tucker, GA 30083, USA
www.durhamgeo.com www.slopeindicator.com

WESTSIDE CAPITAL, L.L.C.

ENTERPRISE RETENTION POND, L.L.C.

N: 405,093.779
E: 1,460,884.257

N 71°32'45" E – 327.26'

S59°28'09"E 59.55'

S02°53'16"E 71.08'

S02°53'16"E – 193.06'

S72°30'29"E 71.08'

S72°30'29"E – 203.80'

S67°33'57"E – 297.52'

S59°28'09"E 43.89'

BANKLINE OF POND

S 68°45'12" E – 318.47'

S69°21'14"E 42.33'

S71°23'17"E 138.12'

S76°38'39"E 48.82'

S 73°41'04" E – 345.05'

N: 404,288.743
E: 1,463,050.615

ZONE "AH"
EFFECTIVE B.F.E.=3'

LOCATION OF EFFECTIVE ZONE LINE

ZONE "D"
EFFECTIVE ZONE

EXISTING POND

EXISTING MOUND

CROWN OF MOUND

TOE OF MOUND

CROWN OF MOUND 9.8

DITCH

SEWERLINE

UNDERGROUND ELECTRIC LINE

OVERHEAD POWERLINES

WESTSIDE BOULEVARD EXTENSION

INVERT= 1.10'

INVERT= 1.15'

N 18°27'25" W – 1,253.68'

(2) 42" R.C.P.

INVERT= 0.20'

INVERT= 0.22'

INVERT= 0.24'

INVERT= 0.29'

INVERT= 0.60'

INVERT= 0.87'

INDEPENDENCE DR.

BENCHMARK
CHISELED SQUARE SET
ELEV.=5.02'
(N.A.V.D. 88, C4G-LSU)

85.745 ACRES

CURVE DATA

1	ARC=50.03' RAD=1,275'
	CHRD=N13°22'41"W–50.03'
2	ARC=250.30' RAD=1,275'
	CHRD=N12°49'49"W–249.90'

N: 402,960.898
E: 1,461,538.184

S 88°27'39" W – 1,358.11'

TERREBONNE PARISH CONSOLIDATED GOVERNMENT

N 88°27'39" E – 882.62'

TRACT W–X–Y–Z–W (1.012 ACRES)

S1°32'21"E 50.00'

S 88°27'39" W – 881.01'

(CONCRETE SURFACE)

N 88°27'39" E – 470.96'

TRACT X–TT–WW–Y–X
(0.541 ACRES)

S 88°27'39" W – 470.96'

S88°27'39"W 20.00'

N1°32'21"W 50.00'

TERREBONNE SEWER SYSTEMS, L.L.C.

TRACT VV–UU–OO–NN–VV
(1.554 ACRES)

8" CROSSTEX PIPELINE

22" SHELL PIPELINE

S 88°27'39" W – 1,392.97'

N 88°27'39" E – 1,409.15'

S 88°27'39" W – 1,243.53'

60' RESERVED FOR FUTURE WIDENING

50' PIPELINE SERVITUDE

EXISTING 60' RIGHT-OF-WAY

EXISTING R/W

ENTERPRISE DRIVE EXTENSION

MATHERNE SUBDIVISION

CORPORATE DRIVE

3040 COMMERCIAL PARK SUBDIVISION

ARC=1,423.00' RAD=2,791.86'
CH=S 58°29'39" E–1,407.51'

30' DRAINAGE SERVITUDE

ARC=102.62' RAD=81.78'
CH=S 26°44'27" W–96.31'

N: 403,088.266
E: 1,464,388.966

ARC=175.19' RAD=320'
CH=S71°39'44"W–173.01'

EXISTING R/W

FLOOD INFORMATION:
THIS PROPERTY IS LOCATED IN ZONES "AH" & "D" AS SHOWN ON THE FEDERAL EMERGENCY MANAGEMENT AGENCY RATE MAP, COMMUNITY NO. 225192C, PANEL NO. 0235, SUFFIX "E", AND DATED SEPTEMBER 7, 2023. ZONE "AH" HAS A B.F.E. REQUIREMENT OF 3' AND ZONE "D" IS A UNDETERMINED FLOOD HAZARD AREA.
PLEASE CHECK WITH THE PARISH FLOOD PLAIN MANAGER FOR POSSIBLE FUTURE CHANGES IN THE BFE REQUIREMENTS PRIOR TO CONSTRUCTION.

THIS OFFICE WAS NOT FURNISHED WITH AN ABSTRACT OF THE PROPERTY THEREFORE THIS MAP DOES NOT PURPORT TO SHOW ALL SERVITUDES, RIGHT-OF-WAYS, EASEMENTS OR OTHER PHYSICAL OBJECTS THAT MAY AFFECT THE PROPERTY SURVEYED.

ALL SURVEY CONTROL IS US FEET, ESTABLISHED BY GPS OBSERVATIONS AND POST PROCESSED WITH NGS C4G USING GEOID 18, THE VERTICAL DATUM IS NAVD '88 AND THE HORIZONTAL DATUM IS NAD 83, LOUISIANA SOUTH ZONE 1702.

JOB NO. : 319 FIELD BOOK : 476 ADDRESS : ENTERPRISE DR CAD NAME : TGHS-WESTSIDE-BLVD-MSMND_25-319
DRAWN BY : BM PAGES : 48 SURVEY FILE : "MATHCOMP.TXT" FOLDER : TERREBONNE GENERAL HEALTH SYSTEMS CRD: TERREBONNE GENERAL HEALTH SYSTEMS – ENTERPRISE & CORPORATE

LEGEND
- ● INDICATES IRON ROD SET
- ○ INDICATES IRON ROD FOUND
- ■ EXISTING METAL POWER POLE
- x INDICATES SPOT ELEVATION
- Ⓜ INDICATES SEWER MANHOLE
- E INDICATES ELECTRIC BOX
- T INDICATES TELEPHONE BOX

I CERTIFY THAT THIS SURVEY WAS DONE UNDER MY DIRECT SUPERVISION IN ACCORDANCE WITH THE MINIMUM STANDARDS OF PRACTICE FOR LAND SURVEYORS AND THAT THE ACCURACY STANDARDS ARE IN ACCORDANCE WITH CLASS "C" SUBURBAN SURVEYS AS INDICATED IN THE ABOVE STANDARDS.

Surveyor's Signature: _____

Surveyor's Name: KENETH L. REMBERT, PROFESSIONAL LAND SURVEYOR

Firm: KENETH L. REMBERT LAND SURVEYORS

Registration Number: 331

29 SEP 25	BM	TO SHOW ELEVATIONS
18 SEP 25	BM	TO SHOW POND AND MOUND
18 FEB 22	BM	TO SHOW WESTSIDE BLVD. PAVEMENT & INSET
01 FEB 22	BM	TO SHOW CONCRETE AND UTILITIES
REVISIONS		

STATE OF LOUISIANA
KENETH L. REMBERT
REG. No. 331
REGISTERED PROFESSIONAL LAND SURVEYOR

PLAT SHOWING PROPERTY BELONGING TO TERREBONNE PARISH HOSPITAL SERVICE DIST. #1 HEALTH & WELLNESS CENTER LOCATED IN SECTIONS 5, 33 & 101, T17S–R17E, TERREBONNE PARISH, LOUISIANA

Keneth L. Rembert, PLS
— L A N D S U R V E Y O R S —
635 SCHOOL STREET, HOUMA, LOUISIANA 70360
(985) 879–2782 FAX – (985) 879–1641

GRAPHIC SCALE
100' 50' 0 100' 200'

DRAWN: B.M.
CHK'D.: K.L.R.
SCALE: 1" = 100'
DATE: 06 JAN 22