



PROJECT MANUAL

DESIGN DEVELOPMENT

01 JULY 2025

TRINITY COMMONS

*1315 JACKSON AVENUE
NEW ORLEANS, LOUISIANA*

EDR Project No. 24041

VOLUME 1 OF 1

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SECTION 00 01 03
PROJECT DIRECTORY

PART 1 GENERAL

1.01 PROJECT DIRECTORY

- A. Owner: Trinity Episcopal Church and School.
 - 1. Address: 1315 Jackson Avenue.
 - 2. City, State, Zip: New Orleans, LA 70130.
 - 3. Phone: (504) 522-0276.
- B. Owner/Representative:
 - 1. Representative: Allison Stouse
 - a. Email: alisonstouse@me.com
- C. Architect: Eskew+Dumez+Ripple.
 - 1. Address: 400 Lafayette Street.
 - 2. City, State, Zip: New Orleans, LA 70130.
 - 3. Phone: (504) 561-8686.
 - 4. Contacts:
 - a. Steve Dumez, Principal, Director of Design
 - 1) sdumez@eskewdumezripple.com
- D. Structural/ Civil Engineer: Fox-Nesbit Engineering, LLC
 - 1. Address: 1515 Poydras, Suite 1012
 - 2. New Orleans, LA 70130
 - 3. Phone: 504:500:9640 x 134
 - 4. Contact: Matthew R. Harmon, P.E.
 - 5. E-mail: mharmon@fox-nesbit.com
- E. Mechanical/Electrical Engineer: Salas O'Brien.
 - 1. Address: 541 Julia St #200, New Orleans, LA 70130.
 - 2. Phone: 225.766.8002.

3. Contact: Joe Starring.
4. E-mail: joe.starring@salasobrien.com.

F. Landscape Architect: Spackman Mossop and Michaels

1. Address: 1824 Sophie Wright Pl, New Orleans, LA 70130
2. Phone: (504) 218-8991
3. Contact: Emily Bullock
4. Email: emily@smm.studio

G. Food Service Consultant: Futch Design Consultant

1. Address: 7948 Goodwood Blvd., Baton Rouge, Louisiana 70806
2. Phone: 225-923-1289.
3. Contact: Greg Futch
4. Email: greg@futchdesign.com

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 00 01 03

SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: TRINITY COMMONS
- B. Owner's Name: Trinity Episcopal Church and School.
- C. Architect's Name: Eskew+Dumez+Ripple, APC.
- D. The Project consists of the construction of New Construction of 1-story dining hall addition with restrooms and kitchen.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 60 00 - PROJECT FORMS.

1.03 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of demolition and removal work is shown on drawings and specified in Section 02 41 00.

1.04 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. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Date of Substantial Completion.

1.05 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.06 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.

- B. Arrange use of site and premises to allow:
 - 1. Work by Others.
 - 2. Work by Owner.
 - 3. Use of site and premises by the public.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Time Restrictions:
 - 1. Limit Work to normal business working hours of 7:30 a.m. to 6:30 p.m., Monday through Friday, or as required by City ordinances.
 - a. Weekend Hours: Same as weekday with 72-hr prior Owner approval.
 - b. Early Morning Hours: With 72-hr prior Owner approval.
 - c. Holidays recognized by the City or the State: With 72-hr prior Owner approval.
- E. Utility Outages and Shutdown:
 - 1. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 72-hr notice to Owner and authorities having jurisdiction.
 - 2. Prevent accidental disruption of utility services to other facilities.
- F. Use of Existing Building:
 - 1. Maintain existing building in a weathertight condition. Repair damage caused by construction operations. Protect building and its occupants; refer to Section 01 50 00 - Temporary Facilities and Controls.

1.07 ADDITIONAL ESTIMATING SERVICES AND SCHEDULE OF VALUE

- A. As a contractual requirement of this project, Contractors, Sub-Contractors, and Suppliers shall provide additional estimating services in a timely manner and a detailed Schedule of Values breakdown of the Contract sum as needed to assist the Owner in conforming with project funding requirements.
 - 1. This may include, but shall not be limited to, the following:

- a. Highly detailed breakdowns of construction values, which may separate similar scope items into multiple line items.
 - b. Estimating cost and time for modifications, additions, and deletions to the Documents requested by the Owner.
 - c. Estimating alternative scenarios in order to document costs of demolition and replacement relative to repairs of similar items.
 - d. Estimating the costs of alternative material and methods.
 - e. Any other project funding requirements.
2. The Contractor shall be required to meet with the Owner, Design Team, and Agencies, as deemed necessary by the Owner, to reconcile estimates and to assist in the alignment of project costs with funding resources.

1.08 SPECIFICATION FORMAT AND CONVENTIONS

- A. The Specifications are organized into Divisions and Sections using the CSI's "MasterFormat 2016 Edition" numbering system.
- B. Sections in Division 01 govern the execution of the Work of all Sections in the Project Manual.
- C. The use of "Related Requirements" is an aid to draw attention to other specification sections dealing with Work directly related to respective Section and does not, in any way, relieve the Contractor's responsibility for coordination of the Work.
- D. Specification section references noted on Drawings by (Section) numbers enclosed in parentheses, i.e. (09 91 23) are an aid to the Contractor in locating the material noted on respective Drawing(s) and do not, in any way, relieve the Contractor of the responsibility for furnishing a material that may be specified in another, unreferenced Section. Section references are not intended to direct specific trades to perform specific Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 10 00

SECTION 01 56 39
LANDSCAPE PROTECTION DURING CONSTRUCTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes the protection and trimming of trees and landscape that interfere with or are affected by the execution of the Work, whether temporary or new construction.

1.02 DEFINITIONS

- A. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- B. Tree Dripline is the circular area centered on the tree trunk as defined by the outermost circumference of a tree canopy where water drips from and onto the ground.
- C. Compost Filter Sock is a three-dimensional tubular sediment control and stormwater runoff filtration device typically used for perimeter control of sediment and soluble pollutants (such as phosphorus and petroleum hydrocarbons), on and around construction activities.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.04 SCOPE OF WORK

- A. The scope or extent of work required under the sections of this division consists of all work and furnishing all related items necessary to complete the work described in these specifications and/or indicated on the project drawings. This includes, but is not limited to the following items:
 - 1. Pre-Installation Conference
 - 2. Arborist's Tree Preservation Plan
 - 3. Tree Protection Fencing
 - 4. Installation of Work and Utility Lines Within Dripline of Trees
 - 5. Tree and Root Pruning
 - 6. Erosion and Sediment Control and Storm Water Runoff Filtration
 - 7. Maintenance of Property
 - 8. Tree Damage Remediation

1.05 ACTION SUBMITTALS

- A. General: Submit each item as described in this technical specification.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
- C. Material Data and Samples for each type of material specified:
 - 1. Organic Mulch: Sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 - 2. Compost Filter Media:
 - 3. Filter Fabric for Compost Filter Sock:
 - 4. Protection-Zone Fencing: Assembled Samples.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1.06 INFORMATION SUBMITTALS

- A. Qualification Data: for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names, addresses, and point of contact, and names and addresses of architects and owners, and other information specified.
- B. Certification Data: By a qualified arborist, certifying that trees indicated to remain have been protected during construction according to this specification, the contract drawings, and recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From a qualified arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.07 QUALITY ASSURANCE

- A. For any work involving pruning, removal, treatment, or protection of trees:
 - 1. Any Construction work which occurs within the dripline of a tree requires the presence of a Louisiana licensed Arborist to ensure that correct arboreal practices are followed.

2. The Contractor shall be responsible for hiring a licensed and insured Arborist to trim any trees or tree roots and perform any other tree related work within the limits of construction. The Contractor shall provide an Arborist, certified by the International Society of Arboriculture, and licensed by the Louisiana Horticultural Commission, to perform all tree work. The Arborist shall have knowledge of the natural habits of the trees so that their natural crown shapes will be preserved when removing any of the wood (branches, leaders, etc.). The Arborist shall have a minimum of five (5) years of experience as a licensed Arborist and be submitted at Pre-Construction Meeting for approval by the Landscape Architect. The Tree Service firm engaged by the Contractor must have successfully completed tree protection and trimming/remediation work similar to that required for this project and submit evidence of the experience.
- B. Standards: The Contractor must meet all requirements and recommendations of the applicable portions of the latest edition of the Standards listed below:
 1. United States Department of Agriculture (USDA)
 2. American National Standards for Tree Care Operations, ANSI A300. American National Standards Institute, 11 West 42nd Street, New York, NY 10036.
 3. International Society of Arboriculture (ISA)
- C. Tree Pruning Standards: Comply with the National Arborist Association “Pruning Standards for Shade Trees” except where more stringent requirements are indicated.
- D. The Arborist must submit any proposed product specifications and rates of applications to the Landscape Architect for approval a minimum of two (2) weeks prior to application.
- E. In instances where construction damage occurs to existing trees, the Contractor shall use the retained Louisiana licensed Arborist to perform all tree related work. Under no circumstances may anyone other than a Louisiana Licensed Arborist perform work on any trees.
- F. The Contractor shall be responsible for notifying the Arborist with sufficient advanced notice to trim any trees or tree roots and perform any other tree related work within the limits of construction. The Contractor shall have Arborist install the tree protection fencing and perform all tree work.
- G. The compost used for the project shall qualify the Test Methods for the Examination of Composting and Compost (TMECC) laboratory guidelines. Compost shall be produced using an aerobic composting process meeting Code of Federal Regulations (CFR) 503.

1.08 FIELD CONDITIONS

- A. The following practices are prohibited within protection zones:
 1. Storage of construction materials, debris, or excavated material.
 2. Moving or parking vehicles or equipment.

3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Fertile, friable, surface soil containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1 inch (25 mm) in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches (100 mm) or more; do not obtain from bogs or marshes.
- B. Geotextile Fabric: shall be in accordance with subsection 203.08 of the LADOTD standard specifications.
- C. Tree Wound Treatment: Utilize tree wound treatment coatings only if recommended by the Licensed Arborist.
- D. Compost Filter Media for Compost Filter Sock: Compost used for compost filter sock filler material (Filter media) shall be weed free and derived from a well-decomposed source of organic matter. The compost shall be produced using an aerobic composting process meeting CFR 503 regulations including time and temperature data. The compost shall be free of any refuse, contaminants, or other materials toxic to plant growth. Non-composted products will not be accepted. Test methods for the items below should follow US Composting Council Test Methods for the Examination of Composting and Compost (TMECC) guidelines for laboratory procedures:
1. PH-5.0 to 8.0 in accordance with TMECC 04.11-A, "Electrometric pH Determinations for Compost".
 2. Particle size – 99% passing a 2 inch sieve and a maximum of 40% passing a 3/8 inch sieve, in accordance with the TMECC 02.02-B, "Sample Sieving for Aggregate Size Classification".

3. Moisture content of less than 60% in accordance with standardized test methods for moisture determination.
 4. Material shall be relatively free (<1% by dry weight) of inert or foreign man made materials.
 5. A sample shall be submitted and approved by the Landscape Architect prior to being used and must comply with all local, state, and federal regulations.
- E. Filter Fabric for Compost Filter Sock: The compost filter sock shall be 12 inches in diameter. The external fabric for the filter sock shall be made of polypropylene multi-filament yarns that have been UV-stabilized, resists rotting and biological degradation. The fabric shall have a life expectancy of up to 24 months. Material sample will be required and approved by Construction Engineering and Inspection (CE&I) representative prior to installation:
1. The Fabric shall meet the following properties:

Chemical Reaction	Inert to most soil chemicals including alkaline, weak acids and salt	
Property	Test Method	MARV English (Metric)
Tensile Strength (Grab)	ASTM D-4632	370 x 250 lbs (1647 x 1113 N)
Elongation	ASTM D-4632	15 x 15%
CBR Puncture	ASTM D-6241	950 lbs (4228 N)
Trapezoidal Tear	ASTM D-4533	100 x 60 lbs (445 x 267 N)
Wide Width Tensile (Ultimate)	ASTM D-4595	2700 x 1740 lbs/ft (39.40 x 25.39 KN/m)
UV Resistance (500 hrs)	ASTM D-4355	100%
Apparent Opening Area (POA)	ASTM D-4751	70 US Std. Sieve (0.212 mm)
Percent Open Area (POA)	COE-02215	4%
Permittivity	ASTM D-4491	0.28 Sec
Permeability	ASTM D-4491	0.1cm/sec
Water Flow Rate	ASTM D-4491	11-18 gpm/ft ²

- F. Organic Mulch: Cypress mulch is prohibited. Mulch shall be free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
1. Type: Pine Straw Mulch
- G. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:
1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches (2400 mm) apart. High-visibility orange color.
 - a. Height: 48 inches.

- b. Manufacturer: Sentry Diamond Mesh Safety Fence by TENAX, or equal.
- 2. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.
- H. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering.
- I. Mycorrhizal Fungal Inoculate: Mycor Tree Saver, or equal, shall be used as per the manufacturer's directions to tree roots damaged by construction as recommended by the Arborist.
- J. Growth Regulator: The tree growth regulator shall contain the Active Ingredient: Paclobutrazol-22.3 and be able to slow the vegetative growth of plants and trees by inhibiting gibberellins biosynthesis. Apply and use per the manufacturer's directions and cautions to tree roots damaged during construction if recommended by Arborist.
- K. Termite Treatment: The termiticide shall have the Active Ingredient: Imidacloprid-21.4% and shall Target Pests: Subterranean Termites, Drywood Termites, Dampwood Termites, Carpenter Ants, and other wood infesting insects. The termiticide shall feature Imidacloprid in a non-repellent formulation designed to eliminate termites in soil or in damaged wood. The termiticide shall be used as per the manufacturer's directions and cautions to tree roots damaged during construction as recommended by Arborist.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.02 PREPARATION

- A. Pre-installation Conference: Before commencing tree protection, trimming, or any other site work, the Contractor, his grading contractor, his utility contractors, and his Arborist shall meet with the Landscape Architect. The tree protection drawings and specifications, and responsibilities, will be reviewed. The meeting will include a site walkthrough in which potential utility, grade change and foundation conflicts are identified by reviewing the site and grading plan, and utility plans. Hauling routes in and out of the site **MUST** be identified and submitted on a drawing for approval prior to the start of construction.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.03 TREE PRESERVATION PLAN

- A. Following the site meeting, a Tree Preservation Plan formulated by the Contractor's Arborist must be approved by the Landscape Architect prior to the commencement of any site work.
- B. The Tree Preservation Plan shall be based on the Tree Protection Plan drawing from the bid documents, and shall include construction staging and haul routes, which may impact trees, any other pertinent information as required by the Landscape Architect to evaluate existing and proposed conditions. The Contractor must identify those trees which will require trimming to clear for construction (path clear zone) and have the trees trimmed by Arborist prior to beginning construction. The Tree Protection Certification Document, included with this specification, will be signed by the Contractor prior to construction beginning on the site, and reviewed at the Pre-installation Conference.
- C. The Landscape Architect must be notified three (3) working days in advance of the beginning of any work on the jobsite, and for meeting to resolve problems unforeseen on the jobsite.

3.04 TREE PROTECTION FENCING

- A. The Contractor is required to erect an approved Tree Protection Fence of at least four (4) feet in height in locations along the dripline of trees as shown on the drawings to avoid damaging trees and plant materials. Where temporary erosion control and tree protection are required within dripline of existing trees along the lagoon, the contractor shall use tree protection fencing together with an approved compost filter sock for erosion control in lieu of silt fence. Silt fence cannot be used for tree protection fencing. Compost filter sock cannot be part of the silt fence.
- B. Vehicles and materials are not allowed within the fenced barricades. The barricade should be constructed at the dripline of the trees unless otherwise shown on the drawings or approved by the Landscape Architect. The Contractor is responsible for maintaining temporary barricades and fencing to the satisfaction of the Landscape Architect throughout the entire contract period. The barricade must be in place and approved by the Landscape Architect prior to any clearing or site work. The tree protection fencing will be reviewed at each site meeting and any deficiencies shall be rectified immediately. Violations of the tree protection policy may result in the job being shut down by the Landscape Architect at any time.
- C. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected areas except by entrance gates.
 - 1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Landscape Architect.
- D. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Landscape Architect.
- E. Maintain protection zones free of weeds and trash.

- F. Maintain protection-zone fencing and signage in good condition as acceptable to Landscape Architect and remove when construction operations are complete and equipment has been removed from the site.

3.05 TREE PROTECTION

- A. Requirements and responsibilities of Contractor for work adjacent to or within the property:
 - 1. Tree protection zones, haul roads and staging areas shall explicitly follow the terms and conditions of the approved Tree Preservation Plan for that project or site. Any variation must receive the proper approval of the Landscape Architect.
 - 2. The Contractor shall be responsible for damage that they cause to all trees and plant materials on property, for compensation or replacements as determined by the Landscape Architect.
 - 3. Injury to trees, including the misuse or removal of any device placed to protect any tree, is prohibited.
 - 4. Cutting, disturbing, or interfering in any way with the roots of any tree is prohibited. Protect root systems from flooding, eroding, or excessive watering caused by dewatering operations.
 - 5. Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Dumping, pouring, or spilling of oil, concrete mix, salt or salt water or other substances upon any tree, including root system, is prohibited.
 - 6. No track vehicle or heavy equipment will be allowed to work within the drip lines of trees or plant materials.
 - 7. No materials, debris or equipment shall be stored within the drip lines of trees or plant materials.
 - 8. No equipment may be cleaned or repaired under the drip lines of trees or plant material.
 - 9. Fill material shall not exceed two (2) inches within the drip lines of trees and may only occur with the written consent of the Landscape Architect. Deposition of material adjacent to the drip lines of trees, which affects or prevents drainage within the drip line of the tree, or causes water to stand under the tree, is prohibited.
 - 10. Contractors may not attach signs, barricades, equipment or materials to trees or plant materials.
 - 11. Failure to comply with these specifications may result in the Project Architect stopping work at the jobsite.
 - 12. Removal of any tree or shrub growing on property without approval from the Landscape Architect or Project Architect is prohibited.

13. Topping of trees is prohibited.
14. Cutting, trimming, removing, spraying, treating, or planting any tree, shrub, or groundcover on property without prior approval by the Landscape Architect is prohibited.
15. The Contractor shall promptly notify Project Architect of any damage to trees and other plant materials and shall, within such reasonable time, repair or replace the damaged plant materials to the satisfaction of the Landscape Architect or Project Architect.

3.06 WORKING WITHIN DRIPLINE OF TREES

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.
- B. Trenching and excavation within the drip line of trees is not permitted. Only boring is permitted within the drip line; only under the center of the tree beginning one (1) foot out of the drip line and at a minimum depth of thirty (30) inches. If excavation within a tree's drip line is unavoidable, after review and written approval of the Project Architect, hand excavate to minimize damage to root systems. Use narrow-tined spading forks, air-spade, or other approved method of excavation. All work under the drip line is to be done by the Contractor's approved arborist. No roots two (2) inches or over shall be cut. Roots under two (2) inches can be cut with a chainsaw or shears by the Contractor's arborist. If roots larger than two (2) inches are encountered outside of the tree's dripline, excavation shall be suspended, and the Project Architect shall be contacted for direction.
- C. Relocate roots in backfill areas whenever possible. If encountering large, main lateral roots, expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to new construction, and relocation is not possible, the Arborist may be allowed to cut the roots approximately 3" back from new construction after approval by the Project Architect.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain a moist condition and temporarily support and protect roots from damage until they are permanently relocated and covered with backfill.
- E. In the event that a point of ingress/egress is required through a grove of trees and all alternative routes have been investigated, the project Architect may allow a temporary pathway through the grove. Such a route will be as narrow as practical, temporarily covered with eight (8) inches limestone to protect tree roots from heavy machinery and enclosed by protective fencing on both sides. A licensed Arborist must be hired in order to properly prune tree branches damaged by construction equipment. Temporary limestone haul road must be completely removed and the pre-construction condition restored, prior to acceptance of the project.

3.07 INSTALLATION OR REPLACEMENT OF UTILITY LINES

- A. If the installation of new utility lines or the replacement of old utility lines is to take place within the dripline of any existing trees or shrubs, no machine trenching is to be allowed. Only hydraulic jacking (boring), air spading or hand digging is allowed within the plant material's driplines.
- B. The Contractor must notify the Project Architect at least three (3) working days in advance of the prior to any utility line construction within the barricade(s), and within the tree(s) dripline(s). The Contractor is to stake any utilities that are shown to be located under driplines of trees, for the Project Architect's review.
- C. If possible, confine the location of underground utilities to areas away from tree roots. There may be exceptions. When it is necessary to pass close to a tree, corridors must be tunneled under major roots rather than using trenches. Corridors or tunnels must be bored, or air spaded under the center of the tree. Boring or air spading this close to a tree, within a tree's dripline, shall only be permitted under extremely confined urban situations for distances and depths of boring as may be permitted. All final decisions on distances and depths shall be made by a licensed Arborist. In all locations where it is obvious and possible, air spading or boring shall begin one (1) foot outside of the tree's dripline and end on the opposite side of the tree one (1) foot outside of the tree's dripline or canopy. The depth of all air spading or boring shall be a minimum of thirty (30) inches. Contractor to stake out any utility locations prior to starting site work.
- D. All damaged portions of the property, including work resulting from other contracts which have been disturbed by causes due to, or incidental to, work performed under this contract shall be repaired and restored to the satisfaction of the project Architect.

3.08 COMPOST FILTER SOCK

- A. The compost filter sock shall be installed according to this specification, as shown on the plans or as directed by the Project Architect.
- B. Compost filter socks should be installed parallel to the base of the slope or other disturbed area, site perimeters. In extreme conditions (i.e. 2:1 slopes), a second compost filter sock shall be constructed at the top of the slope.
- C. Hardwood stakes (at least 2 inches x 2 inches x 36 inches deep) should be installed every ten (10) feet on center. Start the first stake one (1) foot from the starting part of the compost post and then install the stakes every ten (10) feet until the end of the compost filter sock run. The last stake of the run should be installed one (1) foot from the ending point of the filter sock.
- D. Staking depth for sand and silt loam soils shall be twelve (12) inches and for clay soils the depth shall be eight (8) inches. If the hardwood stakes cannot be used to secure the compost filter sock due to being installed on pavement or extremely compacted soils, use concrete blocks behind the filter sock every ten (10) feet on center.
- E. Loose compost may be backfilled along the upslope side of the compost filter sock, filling the seam between the soil surface and the device to improve the filtration and sediment retention.

- F. Compost filter sock is not to be used in perennial, ephemeral or intermittent streams.

3.09 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
 - 1. The roots shall be pruned in accordance with generally accepted arboricultural practices.
 - 2. The Contractor shall notify the Landscape Architect whenever trees or roots need to be pruned prior to beginning construction. All pruning is to be done under the supervision of a licensed Louisiana arborist.
- B. Root Pruning at Edge of Protection Zone: Prune tree roots by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.10 CROWN PRUNING

- A. Arborist shall prune remaining trees affected by temporary and new construction. Trees to be pruned will have been included in the Tree Preservation Plan. No other trees shall be pruned without prior approval of the Project Architect.
- B. Prune remaining trees to compensate for root loss caused by damaging or cutting root systems. Provide subsequent maintenance during the Contract period as recommended by the Arborist.
- C. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by a licensed Louisiana arborist.
 - 1. Prune to remove only broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
 - 2. Pruning Standards: Prune trees according to the National Arborist's Association "Pruning Standards for Shade Trees" and ANSI A300 (Part 1).
- D. Pruning standards: Prune trees in accordance with the National Arborist's Association "Pruning Standards for Shade Trees".
 - 1. Class II: Standard pruning
 - 2. Class III: Hazard pruning
 - 3. Class IV: Crown reduction pruning
- E. Cut branches with sharp pruning instruments; do not break or chop.

- F. Do not paint or apply sealants to wounds.
- G. Chip branches removed from trees. Spread material where indicated or directed by Project Architect.

3.11 REGRADING

- A. Where new finish grade is indicated below existing grade around trees, install grade stakes to indicate new elevation and review with the Project Architect prior to excavation.
- B. Where tree roots interfere with placement of new multi-use path, whenever possible ramp over roots using a minimum of six (6) inches gravel bed and filter cloth between the gravel bed and new concrete. Any new grades must be reviewed and approved in writing by the Project Architect prior to installation. Do not place expansion joints over roots, only use control joints.
- C. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- E. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.12 TREE DAMAGE REMEDIATION

- A. In the event that trees or roots within the tree protection fencing are damaged as the result of a construction project, due to the fault of the Contractor, as determined during the punch list final walkthrough of the site or during construction, the Contractor will be required to hire a licensed Arborist to perform the following work at the contractor's expense:
 - 1. Root Pruning
 - a. All roots of trees damaged during removal of curbs, sidewalk, and driveways shall be root pruned. All tree roots damaged during any excavation operation; including yard drains, collector lines, etc., shall be root pruned if exposed surface roots are visible adjacent to excavation. If tree roots greater than two (2) inches in diameter are encountered during construction, the contractor shall notify a licensed Arborist immediately before taking any further action.
 - b. The trees or roots shall be pruned in accordance with generally accepted arboricultural practices.
 - c. The Contractor shall notify the Project Architect whenever trees or roots need to be pruned prior to beginning construction. All pruning is to be done under the supervision of the Landscape Architect, by the Contractor's arborist.

- d. Excavation of roots that need to be pruned must be done by hand within the dripline of the trees, if necessary and required by arborist and Landscape Architect.
2. Termite Treatment: All trees root-pruned due to construction shall be treated for termites.
3. Mulching
 - a. A two (2) inch layer of mulch shall be applied over all construction damaged tree root zones. Water and maintain in a moist condition until permanent backfill is installed.
 - b. No mulch shall directly contact the tree trunk.
4. Irrigation and Drainage:
 - a. An adequate, but not excessive, supply of water shall be supplied to the root zone of all construction damaged trees for a minimum period of one (1) year from the time of the damage. Irrigation shall consist of a long, slow soak over the entire root zone as often as is necessary to keep the top twelve (12) inches of soil moist.
 - b. Overwatering and frequent shallow watering are prohibited.
5. Vertical Mulching: In instances where soil compaction or grade increases of over two (2) inches have occurred, the root zone of the affected tree shall be aerated through the drilling of two (2) to four (4) inch diameter holes utilizing a coring drill or auger. The holes shall be made three (3) feet on center throughout the root zone of the tree to a depth of at least twelve (12) inches. The holes shall be filled with organic mulch such as wood chips, decomposed pine bark, shredded bark, or pine needles.
6. Radial Aeration: May be performed as an alternative to vertical mulching in instances where soil has been compacted or grade increases of over two (2) inches have occurred. Utilizing a compressed air gun, trenches approximately four (4) inches wide shall be cut in a radial pattern throughout the root zone. The trenches shall begin no closer than four (4) to eight (8) feet from the trunk of the tree to avoid cutting any major support roots. The trenches must extend at least as far as the dripline of the tree. The trenches shall be eight (8) to twelve (12) inches in depth and backfilled with organic compost.
7. Mycorrhizal Fungal Inoculate: Treatment shall be applied per manufacturer's directions, if required by the Arborist.
8. Growth Regulator: An approved tree growth regulator shall be applied to all construction damaged tree root zones per the manufacturer's instructions if required by an Arborist.

3.13 TREE REPLACEMENT

- A. If tree has been removed, or is damaged beyond the point of being salvaged, the Contractor shall be responsible for the cost of compensation or replacement.

1. Provide new trees of the same size and species as the damaged tree. Plant and maintain as specified under Division 2 Section "Trees and Shrubs".
2. Provide new trees of 6 inch (150 mm) caliper size and of a species selected by the project Architect when trees over 6 inches (150 mm) in caliper, measured 12 inches (300 mm) above grade, are required to be replaced.
3. Before final acceptance of the work, all damage done to trees or plant material caused by construction must be repaired. A preliminary assessment will be done during the Substantial Completion walkthrough at which time any damage will be noted on the punch list and the estimated cost of repair/replacement will be withheld. At Final Acceptance, a final assessment will be conducted.

3.14 SITE MAINTENANCE

- A. Maintenance shall commence when construction begins or when any supplies, equipment, fencing, etc. related to construction are placed on site and continues until Final Acceptance. The Contractor is responsible for maintenance or replacement of turf grass and other plant material within the constructed area.
- B. Maintenance shall primarily include mowing with grass to be maintained no higher than 8" at any time.
- C. Maintenance for Compost Filter Sock: Sediment shall be removed once it is accumulated to one-half the original height of the barrier. Compost filter socks shall be replaced whenever it has deteriorated to such an extent that the effectiveness of the compost filter is reduced. Compost filter socks shall remain in place until disturbed areas have been permanently stabilized. All sediment accumulation at the compost filter sock shall be removed and properly disposed of before the compost filter sock is removed.

3.15 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.16 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
 1. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
 2. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch (50-mm) uniform thickness to remain.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 01 56 39

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes administrative and procedural requirements for selection of products for use in project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related sections include the following:
 - 1. Section 01 60 13 - Product Substitution Request Form: For substitution requests of comparable, equivalent or equal products prior to bid.
 - 2. Section 01 42 00 - REFERENCES: For applicable industry standards for products specified.
 - 3. 01 77 00 - CLOSEOUT PROCEDURES: For submitting warranties for contract closeout.
 - 4. Individual Product Sections: For specific requirements for warranties on products and installations specified to be warranted.

1.02 DEFINITIONS

- A. Products: Items purchased for incorporating into the work, whether purchased for project or taken from previously purchased stock. The term "product" includes the terms "materials", "equipment", "system" and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled content materials are allowed. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable or Similar & Equivalent Product (as approved by Architect): Product that is demonstrated and approved through the procurement substitution process to have the indicated qualities related to type, function, dimension, in service performance, physical properties, appearance, warranty, maintenance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis of design", including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, warranty, maintenance,

and other characteristics for purposes of evaluating comparable products or other named manufacturers.

- C. 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.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.03 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's construction schedule and the submittals schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification section number and title
 - b. Generic name used in the Contract Documents
 - c. Proprietary name, model number, and similar designations
 - d. Manufacturer's name and address
 - e. Supplier's name and address
 - f. Installer's name and address
 - g. Project delivery date or time span of delivery period
 - h. Identification of items that require early submittal for scheduled delivery date
 - 3. Initial Submittal: Within thirty (30) days after date of commencement of the work, submit initial product list. Include a written explanation for omissions of data and for variations from contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established in the first third of contract time period.

4. Completed List: Within sixty (60) days after date of commencement of work, submit completed product list. Include a written explanation for omissions of data and for variations from contract requirements.
 5. Architect's Action: Architect will respond in writing to Contractor within fifteen (15) days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. Comparable, Equivalent or Equal Product Requests: Submit request for consideration of each comparable, equivalent or equal product no later than seven (7) calendar days prior to bid or as indicated in Instructions to Bidders. Identify product or fabrication or installation method to be substituted. Include Specification Section number and title and drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation. Architect will make notification of approval or rejection of proposed comparable product request within seven (7) calendar days of receipt of request.
 - a. Form for Submission: Section 01 60 13 - Product Substitution Request Form.
 - b. Method of Approval: Addendum
 - c. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 - Submittal Procedures. Show compliance with requirements.

1.04 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two (2) or more products or systems for use on project, product or system selected shall be compatible with products previously selected, even if previously selected products were also options.
1. The Contractor is responsible for providing products and construction methods compatible with products and construction methods of the Contractor's work and his subcontractors' and vendors' work.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, the Architect will determine which products shall be used.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 5. Protect stored products from damage; and liquids from freezing.
 - 6. Provide a secure location and enclosure at project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.
 - 7. Store cementitious products and materials on elevated platforms.
 - 8. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

1.06 PRODUCT WARRANTIES

- A. Warranties specified in other sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the specifications, prepare a written document using appropriate form properly executed.
 3. Refer to individual specification sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 - Closeout Procedures.

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected", Architect will make a selection. Contractor shall submit physical color charts, chips, or samples produced by the manufacturer or supplier as the Architect requires. Architect will not select colors from electronically transmitted or scanned color charts or chips.
 5. Where products are accompanied by the term "match sample", sample to be matched is Architect's. Contractor may request to view the Architect's sample before the date of bid. After execution of the construction contract, the contract sum or time will not be increased or extended, respectively, for the Contractor to match the Architect's sample.

6. Descriptive, performance, and reference standard requirements in the specifications establish “salient characteristics” of products.
7. Or Equal: Where products are specified by name and accompanied by the term “or equal” or “or approved equal” or “or approved,” comply with provisions in Part 2 “Comparable Products” article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Products: Where specifications include a list of names of both products and manufacturers, provide one of the products listed. Comply with provisions in Part 2 “Comparable Products” Article for consideration of an unnamed product.
2. Manufacturers: Where specifications include a list of manufacturers, provide a product by one of the manufacturers listed. Comply with provisions in Part 2 “Comparable Products” Article for consideration of an unnamed product.
3. Product Options: Where specifications indicate that sizes, profiles, and dimensional requirements on drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Document “Procurement Substitution Procedures” Article for consideration of an unnamed product or system.
4. Basis-of-Design Product: Where specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 “Comparable Products” Article for consideration of an unnamed product by the other named manufacturers.
5. Where no manufacturers or products are listed: Provide products by manufacturers that meet requirements of the Specification Section in which they are listed.
6. Visual Matching Specifications: Where specifications require matching an established sample, select a product that complies with requirements and matches Architect’s sample. Architect’s decision will be final on whether a proposed product matches.
 - a. If no product within specified category matches and complies with other specified requirements, comply with provisions in Part 2 “Product Substitutions” Article for proposal of product.
7. Visual Selection Specifications: Where specifications include the phrase “as selected from manufacturer’s colors, patterns, textures” or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where specifications include the phrase “standard range of colors, patterns, textures” or similar phrase, Architect will select color, pattern, density, or texture from manufacturer’s product line that does not include premium items.

- b. Full Range: Where specifications include the phrase “full range of colors, patterns, textures” or similar phrase, Architect will select color, pattern, density, or texture from manufacturer’s product line that includes both standard and premium items.

2.02 COMPARABLE PRODUCTS

- A. Conditions: Architect will only consider Contractor’s request for comparable product(s) prior to bid. The request for consideration of a comparable product must also meet the following requirements. If the following requirements are not satisfied, Architect will not return requests, except to record noncompliance with these requirements:
 - 1. Evidence that the proposed product does not require extensive revision to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty and maintenance characteristics.
 - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. Sample, if requested.

2.03 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than fifteen (15) days prior to time required for preparation and review of related submittals.
 - 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. Requested substitution provides sustainable design characteristics that specified product provided.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.

- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. 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 after the bidding process and submittal date for the bids.

PART - EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 01 61 16
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.
- C. Requirement for installer certification that non-compliant products were not used within the interior of the building.

1.02 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Section 01 40 00 - Quality Requirements: Procedures for testing and certifications.
- C. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
 - 3. Flooring.
 - 4. Composite wood.
 - 5. Products making up wall and ceiling assemblies.
 - 6. Thermal and acoustical insulation.
 - 7. Other products when specifically stated in the specifications.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Exterior and interior paints and coatings applied on site.
 - 2. Exterior and interior adhesives and sealants applied on site, including flooring adhesives.
 - 3. Wet-applied roofing and waterproofing.

4. Other products when specifically stated in the specifications.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
 1. Stone.
 2. Concrete.
 3. Clay brick.
 4. Metals that are plated, anodized, or powder-coated.
 5. Glass.
 6. Ceramics.
 7. Solid wood flooring that is unfinished and untreated.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers; 2017, v1.2.
- D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board; current edition.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- F. CHPS (HPPD) - High Performance Products Database; Current Edition.
- G. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- H. UL (GGG) - GREENGUARD Gold Certified Products; UL Environment; current listings at <http://productguide.ulenvironment.com/QuickSearch.aspx>.

- I. GreenSeal GS-36 - Standard for Adhesives for Commercial Use; 2013.
- J. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- K. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2017).
- L. SCS (CPD) - SCS Certified Products; Current Edition.
- M. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.05 SUBMITTALS

- A. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

1.06 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
 - 1. Wet-Applied Products: State amount applied in mass per surface area.
 - 2. Paints and Coatings: Test tinted products, not just tinting bases.
 - 3. Evidence of Compliance: Acceptable types of evidence are the following;
 - a. Current UL (GGG) certification.
 - b. Current SCS (CPD) Floorscore certification.
 - c. Current SCS (CPD) Indoor Advantage Gold certification.
 - d. Current listing in CHPS (HPPD) as a low-emitting product.
 - e. Current CRI (GLP) certification.
 - f. Test report showing compliance and stating exposure scenario used.
 - 4. Product data submittal showing VOC content is NOT acceptable evidence.
 - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.

- b. Published product data showing compliance with requirements.
 - c. Certification by manufacturer that product complies with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current SCS "No Added Formaldehyde (NAF)" certification; www.scscertified.com.
 - b. Report of laboratory testing performed in accordance with requirements.
 - c. Published product data showing compliance with requirements.
 - d. Certification by manufacturer that product complies with requirements.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
 - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
 - 2. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
 - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
 - 2. Aerosol Adhesives: GreenSeal GS-36.
 - 3. Joint Sealants: SCAQMD 1168 Rule.
 - 4. Paints and Coatings: Each color; most stringent of the following:
 - a. 40 CFR 59, Subpart D.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).

5. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION 01 61 16

SECTION 01 73 00
EXECUTION

PART 1 - GENERAL

1.01 SUMMARY

- A. The section includes general procedural requirements governing execution of the work including, but limited to the following:
 - 1. Construction layout
 - 2. Field engineering and surveying
 - 3. General installation of products
 - 4. Coordination of Owner-installed equipment
 - 5. Progress cleaning
 - 6. Starting and adjusting
 - 7. Protection of installed construction
 - 8. Correction of the work
- B. Related Sections Include the Following:
 - 1. Section 01 31 00 - Project Management and Coordination for procedures for coordinating field engineering with other construction activities.
 - 2. Section 01 33 00 - Submittal Procedures for submitting for product approval.
 - 3. Section 01 40 00 - Quality Requirements.
 - 4. Section 01 73 29 - Cutting and Patching for procedural requirements for cutting and patching necessary for the installation or performance of other components of the work.
 - 5. 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.

1.02 SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

- D. Certified Surveys: Submit two (2) copies signed by land surveyor.
- E. Final Property Survey: Submit five (5) copies showing the work performed and record survey data.

1.03 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in the jurisdiction where project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. At Notice to Proceed, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the work.
 - 1. Verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. At Notice to Proceed, investigate and verify the existence and location of underground utilities and other construction affecting the work.
 - 1. Verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services. Record information on record documents.
 - 2. Furnish location data for work related to project that must be performed by public utilities serving project site.
- C. Acceptance of Conditions: 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.

3.02 PREPARATION

- A. Existing Utilities Information: Furnish 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 have 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 upon discovery of the need for clarification of the Contract Documents, submit a request for information to the Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation".

3.03 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the work, verify layout information shown on drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of the project.

2. Establish dimensions within tolerances indicated. Do not scale drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Owner.

3.04 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Based replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two (2) permanent benchmarks on project site, referenced to data established by survey and control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on project record documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.
- E. Final Property Survey: Prepare a final property survey showing significant features (real property) for project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, street, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey".

3.05 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 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at 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 produces 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. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the work.
 - 1. Mounting Heights: Where mounting height are not indicated, mount components at heights directed by Architect and Owner.
 - 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.

3.06 OWNER-INSTALLED PRODUCTS (WHERE APPLICABLE)

- A. Site Access: Provide access to project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the work with work performed by Owner's construction forces.
 - 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 within two (2) weeks if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the work depend on Owner's construction.

3.07 PROGRESS CLEANING

- A. General: Clean project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. 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 materials more than seven (7) days during normal weather or three (3) 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.
- 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 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: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- 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.

3.08 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Include test reports in closeout procedures.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation. Comply with qualification requirements in Division 1 Section "Quality Requirements".

3.09 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.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section 01 73 29 "Cutting and Patching".
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- 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 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes procedural requirements for cutting and patching.
- B. Related sections include the following:
 - 1. Individual Product Sections: For specific requirements and limitations applicable to cutting and patching individual parts of the work.

1.02 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 surface to original conditions after installation of other work.

1.03 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least ten (10) days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-place Construction: Describe anticipated results. Include changes to structural elements and operating and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.04 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load carrying capacity or load-deflection ratio.
 1. Including but not limited to concrete slabs on grade, concrete walls, and steel bracing.
- B. 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. Operating elements include the following:
 1. Primary operational systems and equipment
 2. Air or smoke barriers
 3. Fire-suppression systems
 4. Mechanical systems piping and ducts
 5. Control systems
 6. Communication systems
 7. Conveying systems
 8. Electrical wiring systems
 9. Operating systems of special construction in Division 13 sections (if applicable).
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related 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. Miscellaneous elements include the following:
 1. Water, moisture, or vapor barriers
 2. Membranes and flashing
 3. Exterior curtain wall construction
 4. Equipment supports
 5. Piping, ductwork, vessels, and equipment
 6. Noising and vibration-control elements and systems

- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.
- E. Cutting and Patching Conference: Before proceeding, meet at project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.05 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with requirements specified in other sections.
- B. In-Place Materials: Use materials 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 match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut. Provide and submit professional engineered drawings and calculations for support of work to be cut that have been legally prepared and stamped by a licensed professional engineer registered in the state of the project and who is experienced in providing engineering services of the kind required.

- B. 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. Replace work that was damaged during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.03 PERFORMANCE

- A. 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. 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 designated for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to 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. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 - 5. 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.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. 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 possible. Provide materials and comply with installation requirements specified in other sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity on installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extended finish restoration into retained adjoining construction in a manner that will eliminate 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 extended 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, apply primer and intermediate paint coats 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 enclosures to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, glue, and similar materials.

END OF SECTION 01 73 29

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood.
 - 5. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - 6. Plastic buckets.
 - 7. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (<http://flooring.dupont.com>) and Interface (www.interfaceinc.com) conduct reclamation programs.
- E. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.
- F. Develop and follow a Waste Management Plan designed to implement these requirements.
- G. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.

4. Other illegal dumping or burying.

- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 01 50 00 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 01 60 00 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- D. Sections 01 73 00 - EXECUTION, 01 73 29 - CUTTING AND PATCHING, and 01 77 00 - CLOSEOUT PROCEDURES : Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.03 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.

- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

- A. Waste Management Plan: Include the following information:
 - 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
 - 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
 - 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
 - 4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
 - 5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
 - 6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.

2. Submit Report on a form acceptable to Owner.
3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
4. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
5. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 10 00 for list of items to be salvaged from the existing building for relocation in project or for Owner.
- B. See Section 01 33 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- C. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
- D. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
- E. See Sections 01 73 00 - EXECUTION, 01 73 29 - CUTTING AND PATCHING, and 01 77 00 - CLOSEOUT PROCEDURES for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. As a minimum, provide:
 - a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.

- b. Separate dumpsters for each category of recyclable.
 - c. Recycling bins at worker lunch area.
- 2. Provide containers as required.
- 3. Provide temporary enclosures around piles of separated materials to be recycled or salvaged.
- 4. Locate enclosures out of the way of construction traffic.
- 5. Provide adequate space for pick-up and delivery and convenience to subcontractors.
- 6. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 01 74 19

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes administrative and procedural requirements for Contract closeout, including, but not limited to the following:
 - 1. Substantial Completion and Inspection
 - 2. Final Completion and Inspection
 - 3. Punch List
 - 4. Record Documents
 - 5. Warranties
 - 6. Final cleaning of building(s) and site.
- B. Related sections include the following:
 - 1. Individual Product Sections: Specific requirements for operation and maintenance data.
 - 2. Individual Product Sections: Warranties required for specific products or Work.
 - 3. Individual Product Sections: Specific closeout and special cleaning requirements for the work in those sections.
 - 4. Section 01 73 00 - Execution: For progress cleaning of project site.

1.02 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. Submit to the Architect in writing items below that are incomplete in request:
 - 1. Show 100 percent completion for the portion of the work claimed as substantially complete.
 - a. If 100 percent completion cannot be shown, 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 operation and maintenance manuals, workmanship bonds, maintenance service agreements and proposals, test reports, start-up performance reports, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the work and access to services and utilities. Include occupancy permits, operating certificates, final mechanical and electrical inspections, and similar releases by authorities having jurisdiction, as applies.
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. Advise Owner's personnel of changeover in security provisions.
7. Complete startup testing of systems.
8. Terminate and remove temporary facilities from project site, along with mockups, construction tools, and similar elements.
9. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
10. Complete final cleaning requirements, including touchup painting.
11. Touchup and otherwise repair and restore marred exposed finishes to eliminate visual defects.
12. Provide thirty (30) days written notice to the Owner of dates of changeover of electric, gas, water, TV/phone/data, and similar utilities.
13. Provide proof of utility meter installation and request of transfer of utilities to the Owner, as applies.
14. Provide final Testing, Adjustment and Balance reports. Preliminary reports are not acceptable.
15. Perform final cleaning.
16. Change locks and cores to provide Owner access and transmit keys, codes, and keying schedule to Owner.
17. Final property survey:
 - a. Submit final property survey if the Work includes:
 - 1) Civil or Landscaping modifications
 - 2) Demolition of existing building(s)
 - 3) Addition of new building(s)

- b. Final property survey shall contain (at minimum): property lines, surrounding streets, final topographical survey, curbs and curb cuts, ramps, stairs, corners of new and existing buildings, signs, elevations of new and existing floor slabs at building entrances, flood zone classification, identification of trees, identification of paved and landscaping areas, number and type of parking spaces, fences and gates, storm inlets and structures, utilities including poles, manholes, catch basins, vaults, servitudes, and utility company installations, etc. Identify locations and properties of benchmark used.
 - B. Inspection: Submit a written request to the Architect 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 Owner or 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.
 3. The Architect will make one (1) reinspection visit to the site; additional site visits will be deducted from the unpaid funds remaining in the Contract Sum at the Architect's prevailing rate.

1.03 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of final completion, complete the following:
 1. Submit a final application for payment according to Section 01 29 00 - 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 comply with insurance requirements.
 4. Submit pest-control final inspection report and warranty
 5. Submit required warranties (and guarantees) and Maintenance Agreements.
 6. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

7. Prepare and submit record documents.
 8. Prepare and submit final completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 9. Final progress photos.
 10. Removal of all surplus materials that will not be turned over to the Owner.
 11. Proof of completion of items specified in Substantial Completion.
 12. Proof of transmittal of required project construction records to the Owner.
 13. Removal of all temporary facilities and services.
 14. Proof of change of door locks to Owner's access and transmittal of keys, key schedule, combinations, etc.
 15. Receipt for filing Substantial Completion.
 16. Receipt for filing Contract.
 17. Lien and Privilege certificates.
- 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.
- C. Re-inspection:
1. Reinspection: Request reinspection when the work identified in previous inspections as incomplete is completed or corrected.
 2. The Architect will make one (1) reinspection visit to the site; additional site visits will be deducted from the unpaid funds remaining in the Contract Sum at the Architect's prevailing rate.

1.04 PUNCH LIST

- A. Preparation: The Contractor shall prepare a punch list for the project and submit three (3) copies to the Architect. Include name and identification of each space and area affected by construction operations for items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. The Contractor's punch list shall include photos and a description of the item(s). The location of photos within the project shall be easily identifiable in the punch list.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, special finishes, openings, equipment, and building systems.
3. 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
4. Work that has not started and incomplete work will not be reviewed by the Architect during creation of the Architect's punch list.
5. Include an itemized estimate of the cost to complete punchlist work.
6. Submit the punch list to the Architect no less than four (4) days before requesting the Architect to begin creation of the Architect's punch list. Requests for the Architect to create the Architect's punch list shall be in writing.
7. After initial creation of the Architect's punch list, the Architect will visit the site one (1) time to review corrected work. If work marked by the Contractor as "complete" is found not to be complete, the Architect may stop the field visit for the Contractor to re-review and complete the punch list. Additional site visits for the Architect to re-review completed punch list items will be deducted from the unpaid funds remaining in the Contract Sum at the Architect's prevailing rate.

1.05 RECORD DOCUMENTS

- A. Record Drawings: Provide one (1) reproducible set of paper Contract drawings and shop drawings. Also provide record Contract drawings and shop drawings, in color, on one (1) compact disc (CD) or USB thumb drive.
 1. During construction, provide periodic review documents recording work variations.
 2. Store record documents separate from documents used for construction.
 3. Record information concurrent with construction progress.
 4. Mark the set to show the actual installation where the installation varies from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where shop drawings are used, record a cross-reference at the corresponding location on the Contract drawings.
 5. Mark record sets to distinguish between variations in separate categories of the work.

6. Note related change order numbers where applicable.
 7. Organize record drawing sheets into sets and bind with durable paper cover sheets. Mark as "RECORD DOCUMENTS" on the front sheet or cover.
 8. Ensure entries are complete and accurate, enabling future reference by Owner.
- B. Record Specifications: Provide one (1) reproducible paper copy of the Project Manual, including addenda, and one copy of other written construction documents such as ASIs, accepted WCPRs, change orders, and modifications issued in printed form during construction. Also provide these documents, in color, on one (1) compact disc (CD) or USB thumb drive. Note related record drawing information and product data.
1. Record information concurrent with construction progress.
 2. Mark documentation to show variations in actual work performed in comparison with the text of the specifications and modifications.
 3. Mark the manufacturer's name and product model and number of the product(s) or system installed. Include product substitutions or alternates utilized. Include changes made by addenda and other modifications during construction.
 4. Provide photographs of equipment and/or schedule of valve locations enclosed within walls or above ceilings.
 5. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Operation and Maintenance Manuals: Provide three (3) paper copies and an electronic copy of organized operation and maintenance data into sets, organized according to specification section numbers used in the Project Manual, with a table of contents and thumb tab index sheets. Bind indexed data in heavy-duty, 3-ring vinyl-covered, loose-leaf binders, with pocket folders for folded sheet information. Each operation and maintenance manual shall include one (1) copy of each final approved shop drawing in transparent pocket folders. Identify each binder on the front and spine with the typed title "OPERATION AND MAINTENANCE MANUAL", "PROJECT NAME, and "NAME OF CONTRACTOR". Include the following types of information:
1. For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
 2. Include product data, data sheets, and catalog information including size, color composition, and texture; identify specific products used in the work. Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
 3. Supplement product data with drawings to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use project Record Documents as maintenance drawings.

4. Inspection, testing service, lubrication, and maintenance instructions and schedules.
 5. Operating instructions, including start-up and shutdown procedures. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
 6. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
 7. Emergency instructions, names, and phone numbers.
 8. Parts lists and local service organization.
 9. Signed warranties and guarantees required in the specifications.
 10. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
 11. Test reports.
 12. Wiring and piping diagrams.
 13. Other information required by the specifications.
- D. Instruct Owner's personnel for up to three (3) hours in the use of operation and maintenance manuals.

1.06 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. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Warranty Manuals: Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual. Provide one (1) original and two (2) copies of the warranty manual. Also provide these documents, in color, on one (1) compact disc (CD) or USB thumb drive. Provide manual as follows:
 1. Bind warranties (and bonds, if applicable) in heavy-duty, 3-ring vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8 ½ x 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 title “WARRANTY MANUAL”, “PROJECT NAME”, and “NAME OF CONTRACTOR”.

- D. Provide copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer of 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.

PART 3 - EXECUTION

3.01 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in average commercial building cleaning and maintenance program. Comply with manufacturer’s written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire project or for a portion of project:
 - a. Clean project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

- f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - j. Remove labels that are not permanent.
 - k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - l. Do not paint over “UL” and similar labels, including mechanical, electrical, door, frame, hardware, shutter, and fire cabinet name plates.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave project clean and ready for occupancy
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner’s property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from project site and dispose of lawfully.

END OF SECTION 01 77 00

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 01 73 00 - EXECUTION: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.04 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

1. Items which cannot be reinstalled immediately shall be stored on site and protected against construction activities, weather, temperature, and humidity.
2. The Contractor shall provide new items for the Project, with no increase in the Contract Sum and no extension of the Contract Time, where degradation of items caused by insufficient protection occurs during the storage period.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- E. Refurbished Items: Existing items of construction that are not to be permanently removed, but are to be improved by cleaning, repairing, and refinishing to a like-new condition.
- F. Demolish: Same as Remove.

1.05 SUBMITTALS

- A. Site Plan: Indicate:
 1. Vegetation to be protected.
 2. Areas for temporary construction and field offices.
 3. Areas for temporary and permanent placement of removed materials.
 4. May be combined with Site Plan submittal in Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS if required.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
- C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
 2. Demolition firm qualifications.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.06 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 1. Minimum of 5 years of experience.
- B. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 DEMOLITION

- A. Remove paving and curbs required to accomplish new work.
- B. Break up paving within site boundaries to permit natural moisture drainage; leave pieces not larger than 1 square yard.
- C. Within area of new construction, remove foundation walls and footings to minimum 2 feet below finished grade.
- D. Outside area of new construction, remove foundation walls and footings to minimum 2 feet below finished grade.
- E. Remove concrete slabs on grade within site boundaries.
- F. Remove underground tanks.
- G. Remove manholes and manhole covers, curb inlets and catch basins.
- H. Remove fences and gates.
- I. Remove creosote-treated wood utility poles.
- J. Remove other items indicated, for salvage, relocation, and recycling.
- K. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 1. Obtain required permits.

2. Comply with applicable requirements of NFPA 241.
 3. Use of explosives is not permitted.
 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.
- E. Protect existing structures and other elements to remain in place and not removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
 2. Dismantle existing construction and separate materials.

3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 1. Verify construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.
 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
 2. Provide sound retardant partitions of construction and in locations indicated on drawings.

- C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- D. Remove existing work as indicated and required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
 - 2. Remove items indicated on drawings.
- E. Protect existing work to remain.
 - 1. Prevent movement of structure. Provide shoring and bracing as required.
 - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch to match new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00

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, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Pile caps
 - 3. Grade beams
 - 4. Foundation walls.
 - 5. Slabs.
 - 6. Concrete stairs.
- B. This specification section applies to all references in the contract documents to specification section 03 10 00, 03 20 00, or 03 30 00.
- C. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving".

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement. None of the following are allowed in any concrete in this project: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Design Mixtures: Submit a design mixture for each concrete mixture, proportioned on the basis of field experience or trial mixtures, or both, as required by ACI 318-14, chapter 26. Evidence of the ability of the proposed mixture to comply with concrete mixture requirements on the Drawings shall be included. The evidence shall be based on field test records or laboratory trial batches. For concrete mixtures with 28-day compressive strengths greater than 5000 psi, test data shall be provided in accordance with criteria of article 4.2.3 of ACI 301. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amount of mixing water to be withheld for later addition at Project site. The amount of water withheld shall not exceed five percent (5%) of the total batch water.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing but not limited to bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Reproductions made from contract drawings will not be accepted. Submit one (1) electronic print. Review of shop drawings by the Engineer will be for general compliance with contract documents.
 - 1. For reinforced concrete masonry walls, the shop drawings shall include a plan view layout of all filled cell locations, including filled cell locations above and below openings. Shop drawings shall include coordination of all embedded conduits, pipes, and sleeves within hollow cells of concrete masonry.
- D. Field quality-control test and inspection reports.
- E. The scope of the above submittals shall only include the items covered by this Section. Do not include items covered by other Sections such as site paving product data, site paving design mixtures, or site paving steel reinforcement shop drawings.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site (with video teleconferencing capabilities) and verify acceptable date with Architect and Engineer a minimum of one week prior to scheduling.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.

- b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
- 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
 - 3. Contact vapor barrier manufacturer for preinstallation meeting and to coordinate review of the vapor barrier installation either by digital review or in person.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs qualified personnel on the Project, Flatwork Technicians with at least three (3) years experience, Finishers with at least three (3) years experience and a Supervisor with at least ten (10) years experience in concrete finishing and flatwork.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete for Buildings,"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 318, "Building Code Requirements for Structural Concrete."
- G. Concrete Testing Service: Owner shall engage (and pay for) a qualified independent testing agency to perform material evaluation tests. Contractor shall engage and pay a qualified independent testing agency to design concrete mixtures.
- H. Materials and installed work may require testing and retesting, as directed by Architect, at anytime during progress of work. Allow free access to material stockpiles and facilities. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.
- I. For all concrete placement events, all steel reinforcement, other embedded items, and formwork shall be set and finalized a minimum of (3) three hours prior to the time of initial concrete placement to allow time for proper observation/inspection by the design team and the testing agency and time for resolution of any discrepancies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops (if required): Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Forms for Exposed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

- B. Forms for Unexposed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
 - 1. Form foundation elements as indicated on contract documents (typically placed in general notes of the structural plans).
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips (if required): Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
 - 1. All reinforcing bars to be welded shall be ASTM A706, deformed.
- B. Plain-Steel Wire: ASTM A 82.
- C. Deformed-Steel Wire: ASTM A 1064.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 1064, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars (if required): ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view or weather where legs of wire bar supports contact forms (or occur within 1-1/2 inches of surface), use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use either of the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II unless otherwise acceptable to Architect.
 - 2. Blended Hydraulic Cement: ASTM C 595, Type IL (10), 10% limestone substitution.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal for regular sand and gravel mixtures.
 - 2. Maximum Coarse-Aggregate Size: 0.5 inch nominal for sand and pea gravel mixtures. Use a #8 stone aggregate gradation per ASTM C 33 for pea gravel aggregate.
 - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M and potable. Clean and not detrimental to concrete.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc; MiraSTOP.
 - b. CETCO; Volclay Waterstop-RX.
 - c. Concrete Sealants Inc.; Conseal CS-231.
 - d. Greenstreak; Swellstop.
 - e. Henry Company, Sealants Division; Hydro-Flex.
 - f. JP Specialties, Inc.; Earth Shield Type 20.

2.7 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A, 15 mil minimum. Include manufacturer's recommended adhesive or pressure-sensitive tape. The vapor retarder shall maintain a permeance of less than .01 perms as tested before and after mandatory conditioning tests (per ASTM E 1745 Section 7.1 and sub-paragraphs 7.1.2-5).
1. Available Products:
 - a. Fortifiber Building Systems Group; Moistop Ultra.
 - b. Meadows, W. R., Inc.; Perminator.

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- c. Raven Industries Inc.; Vapor Block.
 - d. Reef Industries, Inc.; Griffolyn.
 - e. Stego Industries, LLC; Stego Wrap.
- 2. Vapor proofing mastic: water vapor transmission rate per ASTM E 96 of 0.3 perms or lower.
 - 3. Seam tape: must have a water vapor transmission rate of 0.3 perms or lower in accordance with ASTM E 96

2.8 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Curing compounds must be approved for use with types of floor finishes and sealers/hardeners specified in Contract Documents. Curing compound shall not interfere with bonding of floor covering. The following list of compounds does not indicate acceptance with the floor finishes utilized. Contractor shall only submit for approval curing compounds that are guaranteed not to interfere with bonding of any floor covering. Contractor assumes all responsibility for compliance of curing compounds with respect to this requirement.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Available Products:
 - a. Ashford Formula
 - b. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - c. Burke by Edoco; Aqua Resin Cure.
 - d. ChemMasters; Safe-Cure Clear.
 - e. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
 - f. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - g. Euclid Chemical Company (The); Kurez DR VOX.

- h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; Aqua Kure-Clear.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100 Clear.
 - l. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
 - m. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
 - n. Tamms Industries, Inc.; Horncure WB 30.
 - o. Unitex; Hydro Cure 309.
 - p. US Mix Products Company; US Spec Maxcure Resin Clear.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- 1. Available Products:
 - a. Ashford Formula
 - b. Anti-Hydro International, Inc.; AH Clear Cure WB.
 - c. Burke by Edoco; Spartan Cote WB II.
 - d. ChemMasters; Safe-Cure & Seal 20.
 - e. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
 - f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - g. Euclid Chemical Company (The); Aqua Cure VOX.
 - h. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
 - i. Lambert Corporation; Glazecote Sealer-20.
 - j. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - k. Meadows, W. R., Inc.; Vocomp-20.

- l. Metalcrete Industries; Metcure.
- m. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
- n. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
- o. Tamms Industries, Inc.; Clearseal WB 150.
- p. Unitex; Hydro Seal.
- q. US Mix Products Company; US Spec Hydrasheen 15 percent
- r. Vexcon Chemicals, Inc.; Starseal 309.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips (if required): ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent (if required): ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Reglets (if required): Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- E. Dovetail Anchor Slots (if required): Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

- A. Repair Underlayment (if required): Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment (if required): Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- C. The design mixtures for all exterior, exposed concrete shall provide a minimum of 4.5 percent entrained air.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - a. Do not use high-range water-reducing or super plasticizing admixtures in slabs.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, and concrete required to be watertight.

4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 5. If more than one admixture is used in a concrete mix, assure that only compatible admixtures are used.
 6. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 - a. This requirement does not apply to lightweight concrete.
 - b. Air content for lightweight concrete shall comply with any fire-rated assembly requirements listed by Architect.
 - E. Maximum W/C Ratio: 0.50 and as required to achieve specified concrete strength.
- 2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS
- A. Design mixes to provide concrete with the properties as indicated on the structural drawings.
- 2.13 FABRICATING REINFORCEMENT
- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
- 2.14 CONCRETE MIXING
- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information. The time concrete is unloaded shall be recorded on each batch ticket.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
 2. Batch ticket information shall include information necessary to calculate total mixing water and the amount of water added by the receiver.
 - B. Project-Site Mixing is not allowed.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

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- C. Limit concrete surface irregularities, designated by ACI 117, ACI 301-10 and ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces. Surface Finish 3.0, Smooth Rubbed Finish. EXPOSED TO VIEW.
 - 2. Class C, 1/2 inch for rough-formed finished surfaces – NOT EXPOSED TO VIEW.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise indicated.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install and secure anchor rods prior to placing of concrete.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures as indicated.
 - 5. Provide additional rebar if required to secure rebar dowels in proper location.
- B. Do not run any mechanical/electrical/plumbing pipes or conduit horizontally through concrete slabs, unless approved by the Engineer. These items shall also not bear continuously along grade beams and shall only cross perpendicular over top of grade beam in the concrete thickness below the slab at isolated locations.
- C. Do not run any mechanical/electrical/plumbing pipes or conduit through concrete footings and/or pile caps, unless approved by the Engineer. All mechanical/electrical/plumbing items shall be routed to avoid conflicts with concrete construction.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. If vapor barrier is installed before the grade beam pour, seal vapor barrier to the inside face of grade beams along the entire vapor barrier perimeter using tape with a surface that creates a mechanical seal to freshly-placed grade beam concrete, per manufacturer's instructions. Vapor barrier shall be Stego-Wrap 15 mil or approved equal.
 - 2. If vapor barrier is installed after the grade beam pour, seal vapor barrier to the inside face of grade beams along the entire vapor barrier perimeter using tape and termination bar per manufacturer's instructions. Ensure the grade beam surface is clean and dry prior to adhering tape.
 - 3. Lap joints 12 inches and seal with manufacturer's recommended tape.
 - 4. Repair damaged areas by cutting patches of required vapor retarder, overlapping damaged area 12 inches and taping all four sides with approved tape.
 - 5. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 6. The vapor retarder shall be sealed at the perimeter with manuf. approved tape.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Maximum spacing of bar supports for slab/mat reinforcement shall be 48 inches on center or less as required to secure reinforcement during construction operations.

- E. Precast concrete blocks shall only be used to support reinforcement from the ground. Concrete blocks shall not be used for support of top reinforcement in concrete slabs or mats.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- G. Install bar reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap ends of bars as indicated on the structural contract drawings.
- H. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces as specified on drawings or a minimum of two full mesh if not otherwise specified. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Do not continue reinforcement through sides of strip placements of floors and slabs (unless noted otherwise on drawings).
 - 2. Form joints as indicated on drawings. Do not use metal keyways
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces, where indicated on drawings.
 - 7. Construction joints shall not be placed in any slab areas with floor coverings prone to cracking, unless written approval is provided the Architect. When construction joints are allowed in slab areas with floor coverings prone to cracking, the contractor shall assure that joints are properly considered in floor covering installation as required to prevent reflective cracking.

- C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- D. Doweled Joints (as indicated on drawings): Install dowel bars and support assemblies at joints where indicated.

3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.
 - 1. Place at locations indicated on plans.
 - 2. Place at concrete construction joints below site grade in order to avoid water intrusion into interior space.
 - a. Place at wall to slab (or mat foundation) joints below site grade.
 - b. Place at wall to wall joints below site grade.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
 - 1. All embedded items, including anchor bolts, rebar dowels, etc., shall be set prior to placement of concrete.
 - 2. For foundation elements, verify that water is not present in the excavation prior to placement of concrete.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and in accordance with ASTM C94.

1. Determine initial slump prior to any water addition at Project site and before any significant concrete discharge.
 2. Measure and record water added on Project site and resulting slump.
 3. The amount of water added shall not exceed the amount allowed in the approved design mixture.
 4. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
 5. Do not exceed specified W/C ratio or slump per approved design mixture.
 6. Do not add water to concrete delivered in equipment not acceptable for mixing.
 7. Do not add water if more than 0.25 cubic yards of concrete has already been discharged from the mixer.
 8. All water added shall be under the pressure and direction of flow required to achieve uniformity in concrete. Immediately after addition of water, the drum or blades of the truck mixer or agitator shall be turned an additional 30 revolutions or more if necessary, at mixing speed, until uniformity of concrete is achieved.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not place concrete when temperature is 36 deg F or below or if temperature is expected to reach 36 deg F (or below) within 12 hours of the anticipated time for completing a concrete pour.
 3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301, ACI 305R, and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- G. All elevated concrete slabs in unshored construction (e.g. decks over non-composite steel beam and/or joist systems) shall be placed to a constant thickness matching the thickness indicated on the Drawings.
- H. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: (For formed concrete surfaces not exposed to view) As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: (For formed concrete surfaces exposed to view) As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Unless noted otherwise, all exposed concrete surfaces shall receive a rubbed finish. Consult with Project Architect to determine the type of rubbed finish prior to pouring of concrete. Apply one of the following to smooth-formed finished as-cast concrete as indicated or directed by Architect:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General:

1. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
2. See architectural drawings for slab finish requirements or consult the Project Architect if finishes have not been supplied on the architectural drawings.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.

1. Apply scratch finish to surfaces to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighnten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - a. Finish surfaces to the following tolerances, see structural drawings
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
 - 2. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
 - 2. After broadcasting and tamping, apply float finish.
 - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, 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 indicated or required to complete the 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 at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

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- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
- a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints, unless noted otherwise in documents. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Provide special inspections in accordance with Chapter 17 of the International Building Code for concrete construction.
- B. Inspections:
1. Steel reinforcement placement.
 2. Verification of use of required design mixture.
 3. Mixing and delivery time for concrete.
 - a. Record the time batched, time arrived, and the time unloaded for each batch of concrete.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
 6. Verification of concrete strength before removal of shores and forms from beams and slabs.

- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of discharge for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change or is questionable.
 - a. Determine initial slump prior to any water addition to concrete at Project site and before any significant concrete discharge.
 - b. Measure and record water added to concrete on Project site and resulting slump.
 - c. Record amount of water indicated on batch ticket allowed to be added.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure five standard cylinder specimens for each composite sample.
 - b. Testing Agency shall be responsible for providing curing container for composite samples on Site as required for initial curing period and verifying that standard-cured composite samples are cured in accordance with ASTM C31/C31M. Testing Agency shall document method of initial curing.

- c. The Contractor shall provide secured space, electrical power, and access for initial curing of test specimens.
- 7. Compressive-Strength Tests: ASTM C 39/C 39M.
 - a. Test one specimen at 7 days, three specimens at 28 days, and hold one specimen for testing at 56 days, if necessary.
 - b. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.
- 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work (illustrated via highlighting of elements on structural plans), design compressive strength at 28 days, concrete mixture proportions and materials, concrete unit weight, compressive breaking strength, and type of break for both 7- and 28-day tests. Deviations from the requirements of the Contract Documents shall be clearly identified and described on the reports.
- 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
- 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

- D. Measure floor and slab flatness and levelness, per requirements on drawings, according to ASTM E 1155 within 72 hours of finishing.

END OF SECTION 03 30 00

SECTION 03 35 11
SEALED CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs where marked as "Sealed Concrete".

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
- B. Section 03 30 00 - Cast-in-Place Concrete: Curing compounds that also function as sealers.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Preparation of concrete floors to receive applied finishes.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's published data, including information on compatibility of products and limitations with curing compounds.
- B. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- C. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS

- A. Do not seal floors until interior conditions meet manufacturer's requirements.

1.07 WARRANTY

- A. Correct defective work within a two-year period commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

- A. Unless otherwise indicated, all concrete floors indicated on the Finish Schedule to have "Sealed Concrete" are to be finished using penetrating sealer.

- B. Penetrating Sealer: Transparent, non-yellowing, water- or solvent-based coating meeting VOC requirements specified in Section 01 61 16.
 - 1. Composition: Silane-siloxane mixture.
 - 2. Acceptable Manufacturers:
 - a. Clemons Concrete Coatings: www.clemonsconcretecoatings.com
 - b. Concrete Sealers USA: www.concretesealersusa.com
 - c. TK Products Construction Coatings: www.surecretedesign.com
 - d. PROSOCO: www.prosoco.com
 - e. W.R. Meadows: ww.wrmeadows.com

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

- A. Apply materials in accordance with manufacturer's instructions and written specifications.

3.03 SURFACE TREATMENT APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by treatment manufacturer.
- C. Protect adjacent non-treatment areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply surface treatments in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION 03 35 11

SECTION 04 20 00
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Lintels.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.
- B. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2022a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- E. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016, with Editorial Revision (2018).
- F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2022.
- H. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2017.
- I. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

- J. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- K. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
- L. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
- M. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022.

1.04 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, bonding, and other detailed conditions.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.
 - 4. Nonloadbearing Units: ASTM C129.
 - a. Hollow block, as indicated.
 - b. Normal weight.

2.02 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi), deformed billet bars; galvanized.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss or ladder.
 - 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 - 3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- D. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
 - 1. Concrete frame: Dovetail anchors of bent steel strap, nominal 1 inch width x 0.024 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 2. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

2.03 FLASHINGS

- A. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
- B. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.
- C. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.04 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Weeps:
 - 1. Type: Polyester mesh.
 - 2. Color(s): As selected by Architect from manufacturer's full range.

- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- 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 roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Cut mortar joints flush where fluid-applied or adhered weather barrier is applied and where wall tile is scheduled or resilient base is scheduled.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
 - 1. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 00 - Firestopping.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.07 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHER MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- E. Lap joint reinforcement ends minimum 6 inches.
- F. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- G. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.08 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at nonmasonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
 - 1. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
 - 2. Anchor vertical leg of flashing into backing with a termination bar and sealant.
- C. Extend laminated flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
- D. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.09 LINTELS

- A. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Openings to 42 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
 - 2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
 - 3. Openings over 78 inches: Reinforce openings as detailed.
 - 4. Do not splice reinforcing bars.
 - 5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
 - 6. Place and consolidate grout fill without displacing reinforcing.
 - 7. Allow masonry lintels to attain specified strength before removing temporary supports.
- B. Maintain minimum 8 inch bearing on each side of opening.

3.10 GROUTED COMPONENTS

- A. Lap splices minimum 24 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.
- D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.11 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Form control joint with a sheet of building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- D. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
- E. Form expansion joint as detailed on drawings.

3.12 BUILT-IN WORK

- A. Do not build into masonry construction organic materials that are subject to deterioration.

3.13 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.14 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape, and location.

3.15 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.

3.16 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 04 20 00

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 Division 01 Specifications Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Requirements:
 - 1. Division 09 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- 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 anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
- C. The general contractor is responsible for coordinating the structural steel shop drawing submittal with all other submittals for elements which attach to structural steel or have an effect on structural steel design or detailing. This includes, but is not limited to, elevators, mechanical/electrical equipment, steel joists, pre-engineered metal stairs, railings, suspended partitions, sliding doors, suspended lights, glass storefront/curtainwall, roll-up doors, etc. Hold shop drawing production, ordering of material, fabrication, and other work associated with such elements as required until these other submittals are reviewed and approved. Provide separate submittals for these elements as required. Elevator steel shall be provided in a separate submittal. The general contractor shall coordinate between steel supplier and these other suppliers as required.

1.5 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site (with video teleconferencing capabilities).

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include erection plans, sections, elevations, and details.
 - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data. Provide details of all non-standard connections not specifically indicated on the drawings for approval. Comply with all AISC minimum edge distance and spacing requirements.
 - 3. Include embedment Drawings.
 - 4. Include exact layout of all kicker braces which attach to open-web steel bar joists.
 - 5. Indicate size, material specification, surface preparation and coating for all members and components.
 - 6. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds when backing bars are to remain. Provide welding process and joint designation for all complete-joint-penetration and partial-joint-penetration welds.
 - 7. All required field welding shall be indicated on the erection drawings using erection details.
 - 8. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 9. All column piece drawings shall indicate the grid location of the column.
 - 10. Reproductions made from contract drawings will not be accepted.
 - 11. For structural-steel connections indicated to comply with design loads, include structural analysis data by the qualified professional engineer responsible for their preparation.
 - 12. Shop drawings shall be computer generated using three-dimensional detailing software.

13. The final three-dimensional model shall be transmitted electronically to the Engineer along with submittal of shop drawings. Model is provided for information only. All comments from review will be made on 2D shop drawings. The three-dimensional model shall be submitted in IFC (.ifc) format. A three-dimensional model shall also be sent for all pre-engineered metal stairs.
 14. Allow 21 days for review of structural steel shop drawings, excluding delivery time to and from the contractor.
 15. On projects where submittals are processed electronically, provide Engineer with a minimum of one half-sized copy of shop drawings for office use only.
 16. For shop drawings that are marked "Make Corrections Noted", provide Architect/Engineer with an electronic record set of the shop drawings and three-dimensional model for informational purposes once all revisions are made.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code – Steel," for each welded joint qualified by testing, including the following:
1. Power Source.

1.7 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Qualification Data: For Installer and fabricator.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with top coats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength bolt-nut-washer assemblies.
 4. Shear stud connectors.
 5. Shop primers.
 6. Nonshrink grout.
- F. Source quality-control test reports.

- G. Survey of existing conditions.
- H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- B. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repacking and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturer's written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M or ASTM A 572/A 572M, Grade 50.
- B. Channels, Angles-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Corrosion-Resisting Structural Steel: ASTM A 588/A 588M, Grade 50.

- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.
- F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.
- G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: Standard, unless otherwise noted on drawings.
 - 2. Finish: Black, except where indicated to be galvanized.
- H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirements S11.
- I. Steel Forgings: ASTM A 668/A 668M.
- J. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852 (also referred to as ASTM A 325 Tension-Control), Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563, Grade C (or Grade DH if indicated to be galvanized) heavy hex carbon-steel nuts; and ASTM F 436, Type 1 hardened carbon-steel washers.
 - 1. Finish: Plain, except where indicated to be galvanized.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- C. Threaded and Nutted Anchor Rods (or Anchor Bolts): ASTM F 1554, Grade 55, weldable, straight.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Plate Washers: ASTM A 36 carbon steel.
 - 3. Washers: ASTM F 436 hardened carbon steel.
 - 4. Finish: Plain, except where indicated to be galvanized.
- D. Threaded Rods: ASTM A 36
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Washers: ASTM A 36 carbon steel.
 - 3. Finish: Plain, except where indicated to be galvanized.
- E. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

- F. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Primer chosen shall be compatible with any additional coatings required.
- C. For exposed structural steel, refer to Division 09 sections
- D. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 or ASTM A 780.
1. Dry film shall have at least 94% metallic zinc by weight
 2. Coordinate with Division 09 Sections of field painting if exposed.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
1. All grout shall have a minimum compressive strength of 5,000 psi at 28 days.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 2. Mark and match-mark materials for field assembly.
 3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Do not thermally cut bolt holes in the field or enlarge holes by burning.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes in the field or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- H. All reinforcing bars to be welded to structural steel shall be ASTM A706, deformed, and fabricated in accordance with CRSI's "Manual of Standard Practice."

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned.
 - 2. Use standard bolt holes. Slotted holes are not permitted unless indicated.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth for architecturally exposed structural steel members
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC 303 for mill material.
 - 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

4. All flare bevel groove welds shall be filled flush with top of round surface, unless noted otherwise.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches. This does not apply to columns.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials. This does not apply to intumescent coatings.
 5. Galvanized surfaces.
 6. Top flanges of composite steel beams that are specified to have headed shear studs attached.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).
- E. All structural steel shall be prepared in manner compatible with architectural requirements such as intumescent coatings, applied fire-proofing, high performance coatings, etc. Coordinate to verify compatibility between products chosen and/or methods of preparation. Identify any conflicts to Architect prior to fabrication of structural steel.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
 - 1. Fill vent holes and grind smooth after galvanizing.
 - 2. Galvanize steel lintels and shelf angles attached to structural frame and located in exterior walls.
 - 3. Galvanize steel exposed to weather, U.N.O.
 - 4. Galvanize all other steel specifically indicated on Drawings.
 - 5. Galvanize all anchor bolt assemblies for steel members outside building enclosure.
 - 6. Galvanized anchors and nuts shall be purchased from same supplier and shall be shipped preassembled.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 2. Snug-tighten anchor rods 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 before packing with grout.

3. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
 4. All grout shall be placed under steel column base plates and achieve 70% of its required 28-day strength prior to placement of concrete for elevated floors which are supported by the steel columns.
 5. Grout shall be placed with fluid consistency if column blockouts are used at ground floor slab.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Do not cut holes in structural steel framing unless indicated on structural drawings.
- J. Headed Stud Anchors: Prepare steel surfaces as recommended by manufacturer of headed stud anchors. Use automatic end welding of headed stud anchors according to AWS D1.1 and manufacturer's written instructions. Welding shall develop full capacity of headed stud anchor.
- K. All structural steel diagonal brace members shall be set and attached to the steel frame prior to placement of concrete for elevated floors.
- L. Remove all factory piece markings (especially if welded on to the member) by grinding smooth on all elements to be exposed prior to field painting.

- M. All loose lintels supporting masonry or stone veneer shall be set such that the veneer has a minimum bearing width of 2-1/2 inches. Coordinate lintel placement with Architect at head of door/windows with veneer above.
- N. For members which provide shelf support of masonry or stone veneer, verify accuracy of alignment and elevation prior to permanently fastening. Contact Architect/Engineer if field adjustments to connections of members are required to accommodate tolerances.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned
 - 2. Provide and install a tension-control, high-strength bolt-nut-washer assembly for all bolts on field bolted connections.
 - 3. Use standard bolt holes. Slotted holes are not permitted unless indicated.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth for architecturally exposed structural steel connections.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC 303, "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 - 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 - 5. All flare bevel groove welds shall be filled flush with top of round surface, unless noted otherwise.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
 - 4. Verify all other applicable items as required per Chapter N of AISC 360.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspection.
- C. All inspection and tests shall be performed in accordance with Chapter N of AISC 360.
- D. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Welded Connections: Visually inspect field welds according to AWS D1.1. See structural drawings for additional requirements on weld inspection.
 - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option or as specified on structural drawings:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

1. All corrections shall be submitted to the Project Architect and Engineer for review and approval. Correction work shall not proceed until approval has been provided.
2. Significant deficiencies in construction which require substantial engineering to resolve may require the contractor to secure the services of a professional engineer at no additional cost to the owner. The Project Architect and/or Engineer of Record will determine if a contractor hired engineer is required depending on the severity of the deficiency and the extent of work involved.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780 and manufacturer's written instructions.
- B. Touchup Priming: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 2. Remove all factory piece markings (especially if welded on to the member) by grinding smooth on all elements to be exposed prior to field touchup priming operations. Touchup prime all repaired spots that required field grinding and cleanup which damaged the shop priming.
- C. Touchup Painting: Cleaning and touchup painting for exposed steel are specified in Division 09 painting Sections.

3.7 MISCELLANEOUS STEEL

- A. Unless otherwise indicated on the structural drawings, provide angles, tubes, plates, channels, and other steel members shown on the architectural drawings and connect with 1/4" fillet weld at all material interfaces. Unless otherwise indicated, the following assumptions shall be made regarding spacing and member size shown on the architectural drawings in order to establish an all-inclusive structural steel bid price. Plates-5/16", Cont. Bent Plate- 5/16", Angle-L5x5x3/8, Channel Horizontally Oriented- C12x30, Channel Vertically Oriented-C6x8.2, Wide Flange-W18x35, Tube-HSS 6x6x3/8. Members/pieces shown in section shall be assumed continuous unless otherwise noted. Spacing intervals of stiffeners, hangers, kickers, 30"OC. Columns W6x6X3/8". It is the contractor's responsibility to coordinate and verify all structural steel shapes indicated in architectural drawings, prior to bid.

END OF SECTION 05 12 00

SECTION 05 21 00
STEEL JOIST 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. Section Includes:
 - 1. K-series steel joists.
 - 2. KCS-type K-series steel joists.
 - 3. LH-series steel joists.
 - 4. Joist accessories.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for associated steel framing work.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings: Reproductions made from contract drawings will not be accepted. Submit one (1) electronic print. Review of shop drawings by the Architect/Engineer will be for general compliance with contract documents.
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

3. Indicate locations and details of bearing plates to be embedded in other construction.
4. Indicate that joists are designed for all special loading as given on the structural drawings.
5. All special loading shall be clearly identified and located on joist placement plan in shop drawings.
6. Includes details for discontinuous bridging placement where required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- F. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - 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 to be built into cast-in-place concrete and/or masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level, unless otherwise indicated.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of $1/360$ of the span.
 - b. Deflection limits above apply to all spans of joist, including cantilevered extensions.
 - 3. All special loads indicated on Drawings shall be in addition to allowable loads required by SJI for given span of joist.
 - 4. All joist top chords shall pass bend-check for 300 pound concentrated live load.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists and/or KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists. Deduct area of holes from the area of chord when calculating strength of member.
- 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. Unless noted otherwise, all cantilevered joist extensions shall at a minimum have a capacity equal to the capacity of the main joist span designation.
- G. Camber joists according to SJI's "Specifications". Reduce camber at adjacent joists with varying lengths or at adjacent non-cambered structural steel beams or walls as required to prevent deck installation problems.

- H. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
- B. Primer: Provide shop primer that complies with Division 09 Painting Sections applicable to location and requirements of joist framing.

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. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- C. Furnish 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 of finished wall surface unless otherwise indicated. Provide ceiling extensions at all locations required to accommodate architectural detailing.
 - 1. Finish: Same as joist material.
- D. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- E. Welding Electrodes: Comply with AWS standards.
- F. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.
- G. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing 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 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 instructions, 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 are applied.
- C. Field weld joists to supporting steel bearing plates and framework as per SJI minimum standards or as otherwise indicated on the drawings if the drawings indicate welds which exceed SJI welding standards. 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 high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- E. 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.

- F. Install and connect L1-1/2x1-1/2x3/16 stiffening angles on each side of joist at all concentrated loads applied to joist in accordance with typical detail on structural plans. Weld each end of stiffening angles all around.
- G. Do not make attachments to joist which induce twisting in the joist. All attachments shall be concentric to the joist member.
- H. Where bottom chord bridging conflicts with architectural, mechanical, electrical, plumbing, or other components with fixed locations, omit bridging as required and provide diagonal bridging in adjacent bays as approved by joist supplier and in accordance with joist supplier's requirements. Coordinate bridging locations with other fixed components prior to bridging installation. Adjust and/or provide additional bridging as required to comply with joist supplier's requirements.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner shall engage a qualified independent testing agency to perform tests and inspections and prepare test and inspection reports. Tests and inspection shall be in accordance with Chapter 17 of the International Building Code.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165/E 165M.
 - b. Magnetic Particle Inspection: ASTM E 709.
 - c. Ultrasonic Testing: ASTM E 164.
 - d. Radiographic Testing: ASTM E 94.
- C. Visually inspect bolted connections.
- D. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."
- E. Prepare test and inspection reports.
- F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- G. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2 or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
- B. Related Requirements:
 - 1. Division 03 Section "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
 - 2. Division 05 Section "Structural Steel" for shop- and field-welded shear connectors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Reproductions made from contract drawings will not be accepted. Submit one (1) electronic print. Review of shop drawings by the Architect/Engineer will be for general compliance with contract documents.
 - 1. Include plans showing layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
- D. Evaluation Reports: For steel deck.

- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; 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 the listings of another qualified testing agency.

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Canam Steel Corporation.
 - 2. Epic Metals Corporation.
 - 3. New Millennium Building Systems, LLC.
 - 4. Nucor Corp.; Vulcraft Group. (design basis on structural plans)
 - 5. Valley Joist.
 - 6. DACS, Inc.
 - 7. Cordeck.

8. Consolidated Systems, Inc.
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (minimum yield stress in ksi), G60 zinc coating. At all exposed conditions, galvanized deck shall be cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer. Verify compatibility with top coat specified by Architect.
 2. Deck Profile: As indicated.
 3. Profile Depth: As indicated.
 4. Design Uncoated-Steel Thickness: As indicated.
 5. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
 6. Span Condition: Triple span or more unless not permitted by geometry.
 7. Side Laps: Overlapped.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Fasteners indicated on plans as "Tek Screws" shall be self-drilling tapping screws complying with the material, process, and performance requirements of ASTM C1513. Tek screws shall be corrosion resistant and meet the minimum requirements of ASTM F1941. Provide larger screws if required for attachment to structural steel. Provide screws penetrating joined members by not less than three exposed screw threads.
- E. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- F. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- G. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.
- H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- I. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- J. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- K. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- L. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- M. Galvanizing Repair Paint: ASTM A 780.
- N. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions 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, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work. See structural drawings for 12 gage reinforcement plate required at small openings in the deck.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Deck fasteners shall be in accordance with structural contract drawings.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members as indicated on the plans.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels as indicated on the plans.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option (do not butt at open web steel joist).
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 4 inches apart with at least one fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. mechanically fasten to substrate to provide a complete deck installation.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- B. Tests and inspections shall be performed in accordance with SDI-QA/QC “Standard for Quality Control and Quality Assurance for Installation of Steel Deck.”
- C. Field welds will be subject to inspection.
- D. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- E. Remove and replace work that does not comply with specified requirements.
- F. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
- G. Prior to placement of roofing material over metal roof deck, the Contractor shall notify Testing Agency to perform inspection of roof deck fastening to supporting elements. Roofing material shall not be placed until inspection results are reviewed by Architect and all corrective work is complete.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 09 Section.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior non load-bearing wall framing (Delegated design. See Performance Requirements).
 - 2. Exterior framing (Delegated design).
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Division 9 Section "Gypsum Board Assemblies" 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 shown in plans and/or code requirements and for resisting wind pressures determined from the wind speeds, exposure and risk category provided on plans.
 - 1. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non Load-Bearing Wall Framing: Horizontal deflection of 1/600 of the wall height for walls supporting brick/masonry veneer. Horizontal deflection of 1/360 of wall height for all other walls. Ultimate wind loads may be multiplied by 0.42 as allowed by IBC for purposes of wall deflection limits.
 - b. The above deflection limits apply at all spans of the framing member, including cantilever spans and overhangs.

2. 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.
 3. 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 3/4 inch.
 4. Design cold-formed framing systems to withstand any design loads and forces acting onto the cold-formed framing systems from any storefront/glass assemblies. Proper consideration of point loads from mullions shall be indicated in the design calculations.
 5. Design cold-formed framing systems to accommodate connections of any storefront/glass assemblies.
 6. All framing conditions which preclude the complete usage of cold-formed metal framing as indicated on the construction documents shall be identified prior to bidding or be resolved after bidding at no additional cost to the owner. Provide fixed connections to the structure where required for stability at cantilever conditions. Connections to structure shall be designed and provided by cold-formed metal framing supplier. Only provide fixed connections to structure when required for stability. Do not add kicker braces to reduce the span length of exterior wall studs. Do not attach to bottom flange of steel beams unless indicated on structural drawings.
 7. Design all exterior soffit ceilings to resist positive and negative wind pressure in accordance with ASCE 7. Design soffit framing for dead weight of soffit and for a vertical construction live load of 10 psf minimum and a simultaneous 300 pound point load where erector can stand and otherwise load such framing.
 8. Design interior wall framing for a net horizontal differential pressure of 5 psf perpendicular to the wall surface (in either direction) due to differential interior air pressure between rooms and incidental loading.
 9. Thickness of cold-formed metal framing shall be minimum required for anchorage at all louvers, doors, windows, and other wall openings. Coordinate with applicable supplier for minimum thickness of material for anchorage at framed wall openings.
- 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, spacings, 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. Layout for metal stud wall framing shall include building elevations and/or wall plans indicating applicable wall sections in shop drawings. Provide wall sections for all unique exterior wall framing conditions around perimeter of building, including applicable locations where sections have not been provided in contract drawings. Contact Architect/Engineer prior to submittal of Shop Drawings if any additional information is required. For exterior canopies supported by cold-formed metal framing, the detailing of canopy connections to the cold-formed metal framing shall be clearly indicated on the shop drawings (general contractor shall coordinate loading and connection compatibility between canopy supplier and cold-formed metal stud supplier). For ladders supported by cold-formed metal framing, the detailing of ladder connections to the cold-formed metal framing shall be clearly indicated on the shop drawings (general contractor shall coordinate loading and connection compatibility between ladder supplier and cold-formed metal stud supplier).
 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.
 2. Submit shop drawings, sealed and signed by a qualified Louisiana Registered Civil Engineer.
 - a. Shop drawings shall be computer generated using two-dimensional drafting software (minimum).
 - b. Shop drawings (and all other information necessary for field construction) shall be on completely separate sheets from structural analysis data (calculations).
 3. Allow 21 days for review of cold-formed metal framing shop drawings, excluding delivery time to and from the contractor.

4. For shop drawings that are marked "Mark Corrections Noted", provide Architect/Engineer with an electronic record set of the shop drawings for informational purposes once all revisions are made.
 5. Do not submit shop drawings prior to review and approval of storefront/glass assembly submittals and pre-engineering metal building submittals.
- C. Welding certificates (if any welding is required).

1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. 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.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment 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."
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

- I. The general contractor is responsible for coordinating with the cold-formed metal framing Design Engineer to ensure the metal framing is installed in accordance with the approved shop drawings. The Architect/Engineer is not responsible for verifying proper installation of cold-formed metal framing.
- J. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Framing Alliance, or the Steel Stud Manufacturers Association.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing, not including pre-engineered roof trusses, by one of the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. California Expanded Metal Products Company.
 - 3. ClarkDietrich Building Systems
 - 4. Consolidated Fabricators Corp.; Building Products Division.
 - 5. Custom Stud, Inc.
 - 6. Marino\Ware; a division of Ware Industries.
 - 7. SCAFCO Corporation.
 - 8. Steel Construction Systems.
 - 9. Steeler, Inc.
 - 10. United Metal Products, Inc.
 - 11. Super Stud Building Products, Inc.

2.2 MATERIALS

- 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. Coating: G60, A60, AZ50, or GF30.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G90.
- C. Screws: All screws used in the manufacture of steel roof trusses shall be exterior rated zinc coated self-drilling screws.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- 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: As required by design but in no case less than 0.0428 inch.
 - 2. Minimum Flange Width: 1-5/8 inches.
 - 3. Section Properties: As required by design. See drawings for required depth of wall.
- 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: As required by design but in no case less than 0.0428.
 - 2. Minimum Flange Width: 1-1/4 inches.
 - 3. Section Properties: As required by design. See drawings for required depth of wall.
- C. 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:

1. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428 inch.
 2. Flange Width: 1 inch plus the design gap for 1-story structures.
 3. Section Properties: As required by design. See drawings for required depth of wall.
- D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428 inch.
 - b. Minimum Flange Width: 1 inch plus twice the design gap.
 - c. Section Properties: As required by design. See drawings for required depth of wall.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428 inch.
 - b. Minimum Flange Width: width equal to the sum of outer deflection track flange width plus 1 inch.
 - c. Section Properties: As required by design. See drawings for required depth of wall.
- 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 EXTERIOR FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0329 inch.
 2. Minimum Flange Width: 1-5/8 inches.

3. Minimum section: as required structurally or as specified on plans. See drawings for maximum allowed depth of element.

2.5 FRAMING ACCESSORIES

- A. Fabricate 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.

2.6 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 headless, hooked 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.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
- B. Cement Grout (if required): Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout (if required): Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims (if required): Load bearing, high-density multimonomer plastic, nonleaching.
- E. Sealer Gaskets (if required): Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 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.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

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 7 Section "Building 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.
- K. Exterior Soffit Framing: Provide horizontal and vertical members as required for support of all exterior soffit ceilings. Vertical members shall be provided at all structural steel beam and open web steel joist locations to uniformly distribute weight and loading of soffit ceiling to structure above. Vertical members shall not attach directly to non-composite concrete metal floor decks and metal roof decks. All attachments to open web steel joists shall be made at each panel point location. All kickers shall only be provided between metal stud framing member where required for stability and without interfering with other work or requirements indicated by the drawings. Kicker brace configurations shall not induce torsion or twisting into floor beams or joists and attachments shall be made for direct transfer of horizontal to floor or roof deck, where required for stability.

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. Maximum Stud Spacing: 16 inches, or as indicated.
- 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. At Contractor's option, single or double deflection tracks may be used.
 - 2. Install single deflection track and attach to building structure.

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FRAMING

3. Install double deep-leg deflection tracks and anchor outer track 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 72 inches apart. Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- 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. Provide miscellaneous framing and connections as required for support of all masonry veneer, cast stone bands, and other wall covering elements.

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 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel items.
- B. Prefabricated ladders.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 52 13 - Pipe and Tube Railings.
- C. Section 09 91 13 - Exterior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- J. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.

- K. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- L. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- M. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- N. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.
- P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

- A. 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.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Design Live (Pedestrian) Load: Uniform load of 100 lb/sq ft minimum; concentrated load of 300 lbs.

2.02 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, finish as indicated.

- E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
- 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.
- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Bolts, Nuts, and Washers: Stainless steel.

2.04 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. Fabrications include, but are not limited to, the following:
 - 1. Bollards.
 - 2. Roof hatch access ladder.
 - 3. Loose lintels.
 - 4. Overhead door support framing.
 - 5. Miscellaneous steel supports not included in other sections or otherwise individually described.
 - 6. Note: All of the above mentioned materials may not be used on this project.
- D. 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.

- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.05 FABRICATED ITEMS

- A. Bollards: Steel pipe, Schedule 40, concrete filled, crowned cap, as detailed; galvanized finish.
- B. Lintels: As detailed; galvanized finish.
- C. Door Frames for Overhead Door Openings: Channel sections; galvanized finish.
- D. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
- E. Fabricated Ladders:
 - 1. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
 - a. Side Rails: 3/8 by 2 inches members spaced at 20 inches.
 - b. Rungs: One inch diameter solid round bar spaced 12 inches on center.
 - c. Space rungs 7 inches from wall surface.

2.06 PREFABRICATED LADDERS

- A. Prefabricated, Retractable Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
 - 2. Materials:
 - a. Aluminum Sheet: ASTM B209/B209M, Alloy 5005-H34.
 - b. Aluminum Extrusions: ASTM B221/B221M, Alloy 6063-T6.
 - c. Stainless Steel (for fasteners): ASTM A167/A167M, Alloy 304.
 - 3. Finish: Powder coat; color to be selected by Architect from manufacturer's standard range.

4. Basis-of-Design Product: Subject to the requirements, provide Werner Co.; Model AA2210 or a comparable product by one of the following:
 - a. ALACO Ladder Company, Inc.: www.alacoladder.com.
 - b. Precision Ladders, LLC.; www.precisionladders.com.
- B. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 1. Basis-of-Design Product: Subject to the requirements, provide O'Keefe's, Inc; Model 501 (with heavy duty tubular rail) or a comparable product by one of the following:
 - a. ALACO Ladder Company, Inc.: www.alacoladder.com.
 - b. Precision Ladders, LLC.; www.precisionladders.com.

2.07 FINISHES - STEEL

- A. Prime paint steel items.
 1. Exceptions: Galvanize items to be embedded in concrete and items to be imbedded in masonry in addition to items indicated to be galvanized.
- B. Prime Painting: One coat.
- C. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- D. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- E. Refer to Section 09 91 13 - Exterior Painting for field finishing of galvanized and non-galvanized elements.

2.08 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: superior performance organic coating.
- B. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system; color as selected from manufacturer's standard colors.
- C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.09 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

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 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. Obtain approval prior to site cutting or making adjustments not scheduled.
- D. After erection, prime welds, abrasions and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 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.

END OF SECTION 05 50 00

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors and sleeves in concrete.
- B. Section 09 91 13 - Exterior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- C. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- D. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

1.04 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, 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 seal and signature on each sheet of shop drawings.

1.05 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. Fabricator Qualifications:
 - 1. A company specializing in manufacturing products specified in this section, with not less than ten years of experience.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set.
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
 - 1. Freestanding Rails: 1-1/2 inches diameter, round.
 - 2. Intermediate Rails: 1-1/2 inches diameter, round.
 - 3. Posts: 1-1/2 inches diameter, round.
 - 4. Balusters: 1/2 inch square solid bar.
- F. 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 post anchorage to concrete, provide sleeves not less than 6 inches long with inside dimension not less than 1/2 inch greater than outside dimension of post.
 - 2. Posts: Provide adjustable flanged brackets.
- G. Provide mechanical and welding fittings where indicated to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.
- H. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
 - 1. Ease exposed edges to a small uniform radius.
 - 2. Welded Joints:
 - a. Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.

2.02 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured.
- D. Weld connections that cannot be shop welded due to size limitations.
 - 1. Weld in accordance with AWS D1.1/D1.1M.
 - 2. Match shop welding and bolting.
 - 3. Clean welds, bolted connections, and abraded areas.
 - 4. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

2.03 STEEL FINISHES

- A. Exterior Railings: Galvanized and field-finished as specified in Section 09 91 13 - Exterior Painting.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, for installation as work of other sections.

3.02 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- B. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- C. Anchor railings securely to structure.
- D. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- F. Anchor posts into preset concrete sleeves; fill annular space with nonshrink, nonmetallic grout or anchoring cement.

1. Contractor Option: Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than outside dimension of post. Set post and fill annular space with nonshrink, nonmetallic grout or anchoring cement.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 52 13

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roofing nailers.
- B. Preservative treated wood materials.
- C. Miscellaneous framing and sheathing.
- D. Communications and electrical room mounting boards.
- E. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. AWP A U1 - Use Category System: User Specification for Treated Wood; 2022.
- D. PS 1 - Structural Plywood; 2009 (Revised 2019).
- E. PS 2 - Performance Standard for Wood Structural Panels; 2018.
- F. PS 20 - American Softwood Lumber Standard; 2021.
- G. SPIB (GR) - Grading Rules; 2014.

1.04 SUBMITTALS

- A. Product Data: Provide technical data on wood preservative materials and application instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Spruce-Pine-Fir (South), unless otherwise indicated.
 - 2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Wall Sheathing, For Parapets: PS 2 type.
 - 1. Bond Classification: Exterior.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 24.
 - 4. Performance Category: 5/16 PERF CAT.
 - 5. Edge Profile: Square edge.
- B. Wall Sheathing For Interior Partitions where Indicated: Plywood, PS 1, Grade C-D, Exposure I.

- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- D. Other Applications:
 - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 - 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 - 3. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Preservative Treatment:
 - 1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber in contact with roofing, flashing, or waterproofing.
 - c. Treat lumber in contact with masonry or concrete.
 - d. Treat lumber less than 18 inches above grade.
 - e. Treat lumber otherwise contained in building envelope.
 - 2. Preservative Pressure Treatment of Lumber in Contact with Soil: AWWA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.

- a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.
- b. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA) in exposed exterior applications subject to leaching.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.04 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.

3.06 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.07 CLEANING

- A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

SECTION 06 16 43
GYPSUM SHEATHING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Sheathing penetration treatment.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing.
- B. Section 07 25 00 - Weather Barriers.

1.03 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.04 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site. Review requirements for flashing, including surface preparation specified under other Sections, substrate condition and any pretreatment, special details, installation procedures, inspections, protection and repairs.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, and directions for storing.
- C. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by flashing manufacturer.
- D. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- E. Protect stored materials from direct sunlight.

1.06 WARRANTY

- A. Material Warranty: Provide sheathing manufacturer's standard warranty covering sheathing material for five years commencing on date of purchase by Contractor.

- B. Weathering Warranty: Provide sheathing manufacturer's standard warranty covering in-place exposure damage for six months commencing on date of purchase by Contractor.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.02 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 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. CertainTeed Corporation; GlasRoc.
 - b. G-P Gypsum Corporation; Dens-Glass Gold.
 - c. National Gypsum Co.; Gold Bond eXP.
 - d. Temple-Inland Inc.; GreenGlass
 - e. United States Gypsum Co.; Securock.
 - 2. Types and Thickness:
 - a. Type X, 5/8 inch thick for typical application, unless noted otherwise.
 - 3. Size: 48 by 96 inches or 48 by 108 inches or 48 by 120 inches for vertical installation.

2.03 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Screws for Fastening Gypsum Sheathing to Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with

organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

2.04 SHEATHING PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing penetrations in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine framing; verify that framing and furring members to receive sheathing do not vary more than 1/8 inch vertically and horizontally from outside face of adjacent members.
- B. Ensure through-wall flashing indicated to be installed prior to installation of sheathing is properly anchored and of proper size.

3.02 WALL SHEATHING INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Coordinate location and installation of flashing which penetrates and is attached behind sheathing. Install portions of sheathing beneath flashing as shown on the Drawings.
- C. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- D. Securely attach to substrate by 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."

- E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.03 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to metal framing with screws.
 - 2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs; horizontal installation is not acceptable. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
 - 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Seal penetrations according to sheathing manufacturer's written instructions.

END OF SECTION 06 16 43

SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items including, but not necessarily limited to the following:
 - 1. Wood base.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 09 91 23 - Interior Painting: Painting of finish carpentry items.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- B. Samples: Submit one samples of wood trim 12 inch long.
 - 1. Include documentation indicating that composite wood products and fabrication adhesives contain no urea formaldehyde.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of experience.
 - 1. Single Source Responsibility: Provide and install this work from single fabricator.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- B. Protect from moisture damage.
- C. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Poplar or white birch; prepared for opaque finish unless otherwise noted.

2.02 LUMBER MATERIALS

- A. Softwood Lumber: Poplar or white birch species, plain sawn, maximum moisture content of 6 percent; with flat grain, paint grade.

2.03 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
 - 1. VOC: 70 b/L maximum in accordance with SCAQMD Rule 1168, 2005.
- B. Fasteners: Of size and type to suit application; any finish in concealed locations and stainless steel finish in exposed locations.

2.04 ACCESSORIES

- A. Adhesive: Type recommended by AWI/AWMAC to suit application.
- B. Lumber for Shimming and Blocking: Softwood lumber of pine or fir species.
- C. Primer: Section 09 91 23 - Interior Painting.
- D. Wood Filler: Solvent base, tinted to match surface finish color.

2.05 SITE FINISHING MATERIALS

- A. Field Finishing: See Section 09 91 23.

2.06 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 91 23.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.04 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION 06 20 00

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Hardware.
- C. Factory finishing.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. BHMA A156.9 - Cabinet Hardware; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- B. Product Data:
 - 1. Provide data for hardware and accessories.

2. Include documentation indicating that composite wood products and fabrication adhesives contain no urea formaldehyde.
- C. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet substrate and finish.
- D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum ten (10) years of experience.
 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 2. Single Source Responsibility: Provide and install this work from single fabricator.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Wood Veneer Faced Cabinet:
 1. Exposed Surfaces indicated to have a clear coat finish: HPVA Grade A, _____, _____, _____. Seal all exposed edges.
 - a. Provide any knot free face "A" grade hardwood species for cabinetry indicated to have plastic laminate or opaque finish.
 2. Concealed Surfaces: Manufacturer's option.
- C. Cabinets and doors at Type WD-1:
 1. Finish - Exposed Exterior Surfaces: Wood veneer, with edge banding to match.
 2. Finish - Exposed Interior Surfaces: Wood.

3. Finish - Concealed Surfaces: Manufacturer's option.
4. Casework Construction Type: Type A - Frameless.
5. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.
6. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
7. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
8. Cabinet Style: Flush overlay.
9. Cabinet Doors and Drawer Fronts: Flush style.
10. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

- A. Hardwood Edgebanding, where applicable: Use solid hardwood edgebanding matching species, color, grain, and grade for exposed portions of cabinetry.

2.03 COUNTERTOPS

- A. Countertops: See Section 12 36 00.

2.04 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application containing no urea formaldehyde.
 1. VOC: 70 g/L maximum in accordance with SCAQMD Rule 1168, 2005.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard rubber grommets for cut-outs, in color to blend with adjacent surface.

2.05 HARDWARE

- A. Hardware: BHMA A156.9, types as indicated for quality grade specified.

- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.
- E. Cabinet Catches and Latches:
- F. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Heavy Duty grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self closing/stay closed type.
- G. Hinges: European style concealed self-closing type, steel with satin finish.
- H. Soft Close Adapter: Concealed, frame-mounted, screw-adjustable damper; steel with satin finish.

2.06 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
 - 1. Provide center matched panels at each elevation.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Provide cutouts for plumbing fixtures, inserts, and appliances. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.07 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.
- C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 11, Polyurethane, Catalyzed.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin unless otherwise indicated in the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.

- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06 41 00

SECTION 06 83 16
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Trim.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

- A. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation; current edition.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010 (Reapproved 2018).
- C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- D. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2017.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. FDA Food Code - Chapter 6 - Physical Facilities; Current Edition.
- G. FM 4880 - Evaluating the Fire Performance of Insulated Building Panel Assemblies and Interior Finish Materials; 2017.
- H. ISO 846 - Plastics - Evaluation of the Action of Microorganisms; 2019.
- I. ISO 2812-1 - Paints and Varnishes -- Determination of Resistance to Liquids -- Part 1: Immersion in Liquids Other than Water; 2017.

1.04 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Samples: Submit one samples 6 by 6 inch in size illustrating material and surface design of panels.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

1.06 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: One year from date of Substantial Completion

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Crane Composites, Inc: www.cranecomposites.com/#sle.
 - 2. Marlite, Inc: www.marlite.com/#sle.
 - 3. Nudo Products, Inc: www.nudo.com/#sle.
 - 4. Panolam Industries International, Inc: www.panolam.com/#sle.

2.02 PANEL SYSTEMS

- A. Wall Panels:
 - 1. Panel Size: 4 by 9 feet.
 - 2. Panel Thickness: 0.09 inch.
 - 3. Surface Design: Smooth.
 - 4. Color: White.
 - 5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

- A. Panels: Glass fiber reinforced plastic (FRP), complying with ASTM D5319 and meeting USDA requirements.
 - 1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.

2. Class 1 fire rated when tested in accordance with FM 4880.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. Impact Strength: Greater than 6 ft lb force per inch, when tested in accordance with ASTM D256.
 5. Sanitation and Cleanability: Comply with 9 CFR 416.2.
 6. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.
 7. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with ISO 2812-1.
 8. Biological Resistance: Rating of 0, when tested in accordance with ISO 846.
- B. Trim: Vinyl; color coordinating with panel.
- C. Adhesive: Type recommended by panel manufacturer.
- D. Sealant: Silicone; white.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

- I. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION 06 83 16

SECTION 07 08 10
BUILDING AIRTIGHTNESS REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administration and Coordination of Air Barrier System (ABS) Installation.
2. Building Airtightness Testing & Inspection.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - QUALITY REQUIREMENTS: For administrative and procedural requirements of testing and inspections.
- B. Division 07 Sections for air-barrier materials and specific quality control requirements for individual construction activities.

1.03 DEFINITIONS

- A. Air Barrier System (ABS): The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 PERFORMANCE REQUIREMENTS

- A. The installed ABS shall conform to the following requirements:
 1. Building Air Leakage Rate: The air leakage rate of the building exterior envelope shall not exceed 0.25 cfm/ft² at a pressure differential of 0.3" w.g. (1.57 psf or 75 Pa) in accordance with ASTM E779-03.
 2. ABS must be continuous, with all joints made air and water tight.
 3. Structural Integrity: ABS shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure.
 4. ABS shall not displace adjacent materials under full load.
 5. ABS shall be joined in an air-tight, watertight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep.

1.05 REFERENCES

- A. ASTM International (ASTM)

1. ASTM E779 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
2. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
3. ASTM E1827 - Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door.
4. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

B. International Organization For Standardization (ISO)

1. ISO 6781 - Thermal Insulation - Qualitative Detection of Thermal Irregularities in Building Envelopes Infrared Method, First Edition.

1.06 SUBMITTALS

A. Qualification Data: Submit the qualifications of the building airtightness testing firm and include the following:

1. List of the last 5 airtightness testing projects conducted including names and contact information of the clients.
2. Copies of reports on the last 3 building airtightness tests performed.
3. List of references with contact information and relationship.
4. Listing of each piece of equipment, including manufacturer, model number, date of last certification.

B. Test Report(s): Submit not later than 10 days after each test.

1. Report Data: Written reports of each inspection and test or similar service shall include all the Report items described in ASTM E1827. Additionally, the report shall include the following information:
 - a. Date of Issue
 - b. Project title and number
 - c. Name, address, and telephone number of testing agency
 - d. Dates and locations of samples and tests or inspections
 - e. Names of individuals making the inspection or test
 - f. Designation of the Work and test method.

- g. Identification of product and Specification Section
- h. Complete inspection or test data
- i. Test results and an interpretation of test results
- j. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements
- k. Name and signature of test technician
- l. Recommendations for retesting

1.07 QUALITY ASSURANCE

A. Airtightness Testing Firm & Equipment:

- 1. The testing firm shall have documented experience accomplishing air barrier performance testing using fan pressurization methods in accordance with ASTM E779 and E1827 on building of similar size, construction and complexity.
 - a. Demonstrate a thorough working knowledge and understanding of building construction, and in particular exterior envelope systems and HVAC systems.
 - b. Be experienced in diagnostic evaluation of the air barrier performance in accordance with ASTM E1186.
 - c. Thermographer: Meet the following minimum requirements:
 - 1) Level I or Level II Thermographer with education and thermography work experience and having completed application specific training for the use of IR thermography in Building Science.
 - 2) Thermographer must have the following abilities as developed through both training and experience:
 - (a) Thorough knowledge of the operation of the particular infrared imaging system being used.
 - (b) Ability to interpret thermograms and other data used in air barrier testing.
 - (c) Ability to confirm the test conditions are within set limits and are consistent with assumptions that support the interpretation.
 - d. Test Equipment:
 - 1) Blower Fans: Calibrated units capable of both pressurizing and depressurizing the building at various different pressure levels to a maximum pressure of 75 Pa; units shall have been calibrated by an authorized calibration test facility within the previous 12 months.

- 2) Infrared Camera: The infrared imaging system must be radiometric with a minimum Noise Equivalent Temperature Difference (NETD), which is a measurement of thermal resolution or sensitivity, of less than 80mK at 25°C.
- 3) If temperatures are being measured, the parameters (i.e. emissivity, atmospheric temperature, etc.) shall be capable to be adjusted in the camera or by using software. Camera calibration records shall be available upon request.
- 4) The infrared imaging system must have an operating spectral range that falls between 2 and 14 micrometers (pm).
 - (a) The imaging system must have a means of recording radiometric images seen on the camera's screen.
 - (b) The camera's detector array must have no fewer than 320 x 240 pixels.

1.08 MOCK-UPS

- A. Field-Constructed Mock-Ups: Prior to start of Air Barrier System installation, construct mock-ups of each different Air Barrier System condition required for this project; use materials and installation methods/sequence that will be employed in the actual construction of the building.
 1. Apply air barrier on field-constructed mock-ups of assemblies specified in other Sections.
 2. Construct typical wall and roof conditions, at least 8 feet long by 8 feet wide and 8 feet tall, incorporation the following:
 - a. Typical exterior wall framing and sheathing with parapet
 - b. Wall air barrier system
 - c. Exterior cladding materials
 - d. Roofing
 - e. Roof air barrier system
 - f. Window, louver and door frame and sill
 - g. Foam air barrier seal around windows, door and louvers
 - h. Insulation
 - i. Flashing
 - j. Building corner condition
 - k. Junction with roof system
 - l. Junction with foundation

- m. Typical construction, control and expansion joints
 - n. Typical penetrations and gaps; illustrating materials interface and seals.
 - o. Typical penetrations by structural members, conduits, electrical boxes, pipes and ducts.
 - p. Typical penetrations by masonry ties, screws, bolts and similar.
- B. Mock-ups shall demonstrate the proper installation sequence and workmanship required for the Air Barrier System installation to provide an air-tight envelope conforming to the Performance Requirements specified in this Section.
- C. Correct any non-conforming work as identified by Architect and testing agency; mock-ups confirming to requirements of Contract Documents shall become the standard of quality and construction for all subsequent similar conditions.

1.09 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Prior to starting installation of the ABS, convene a pre-installation conference at the job site to review the project conditions and installation requirements.
- 1. Agenda shall include, at a minimum, construction of the mock-up, sequence of construction, substrate condition/preparation, materials approved for use, compatibility of materials, joint between the various different types of air barriers specified, coordination with installation of adjacent and covering materials, and details of construction.
 - 2. Attendance is required by installers of each of the various different air barriers specified and representatives of related trades including covering materials, substrate materials and adjacent materials.
 - 3. The manufacturer's technical representative for each different Air Barrier System specified in this Section shall attend the pre-installation conference and shall provide the following:
 - a. Inspect and approve (along with the installer) the mock-up and the substrate(s) to which the ABS will be installed.
 - b. Review and explain each air barrier system product, including its limitations, the required surface preparation, the environmental requirements and the installation instructions/procedures and requirements for each different substrate and air barrier product.

PART 2 – PRODUCTS

2.01 AIR BARRIER SYSTEM

- A. Provide materials and installation methods to bridge and provide an airtight connection/seal conforming to the Performance Requirements specified in this Section at the following air leakage pathways and gaps:

1. Between the exterior wall air barriers and the roof air barrier.
2. Between the exterior wall air barriers and the slab.
3. Between different substrate materials/systems.
4. Between the various different air barrier products/systems.
5. At control joints.
6. Between the wall air barrier and window frames, storefront frames, and other openings.
7. Between the wall air barrier and door frames.
8. Between the air barrier and any penetrations, including penetrations by piping, conduit, duct, structural members and similar.
9. Masonry ties, screws, bolts and similar penetrations.
10. All other air leakage pathways in the building air barrier envelope.

B. Individual air barrier materials may include those specified in the following Sections:

1. Division 07 Section "Foamed in Place Insulation."
2. Division 07 Section "Weather Barriers".
3. Division 07 Section "Joint Sealants."

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Furnish and install the various different types of air barriers shown and specified to create an Air Barrier System (ABS) covering the entire building envelope constructed to perform as a continuous barrier that will remain adhered in place and durable for the life of the building.
1. ABS shall accommodate movements of building materials by providing for airtight barrier across any building expansion and control joints that may be discovered but not represented on the drawings.
 2. ABS shall accommodate changes in substrate and perimeter sealing conditions.
 3. Different air barrier products shall be permanently joined together where they meet in a manner approved by both manufacturers to provide an airtight juncture.

3.02 FIELD QUALITY CONTROL

- A. Review the air barrier system installation in progress on a daily basis and confirm the following:

1. Air barrier manufacturer's surface preparation and installation instructions are being followed.
2. Temperature and site conditions conform to manufacturer's requirements.
3. Site conditions for application temperature, and dryness of substrates are within guidelines.
4. Continuity of the air barrier system over the entire building with no gaps and all penetrations are sealed allowing for no air infiltration or exfiltration through the air barrier system.
5. Air barrier substrates are continuous and will structurally support the air barrier system to withstand design air pressures.
6. Substrate surfaces are properly primed as recommended by manufacturer.
7. Laps in materials conform to manufacturer's instructions and in no case are less than 3 inches and are shingle-lapped to shed water to exterior side.
8. Mastic is applied on exposed edges of self-adhered membrane air barriers and elsewhere as recommended by manufacturer.
9. Installer is using a roller to achieve/enhance adhesion of self-adhered membranes.
10. Application thickness of liquid-applied materials over the entire surface conform with manufacturer's specifications for the specific substrate.
11. Correct materials are installed for compatibility.
12. Manufacturer recommended transitions are being employed for change in direction and structural support at gaps.
13. Review connection between assemblies (membrane and sealants) for proper cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.
14. Air barrier system is not exposed to the weather longer than recommended by the barrier manufacturer.
15. Test and record the bond strength of coatings and self-adhered membranes to substrate in accordance with ASTM D4541.

3.03 BUILDING AIRTIGHTNESS TEST

- A. A qualified testing firm shall conduct a test of the building for air tightness using calibrated portable blowers in accordance with ASTM E1827 or ASTM E779 and calculate the building air leakage rate. This test is intended to demonstrate that the building construction has produced an effective air barrier so that air infiltration and exfiltration through the exterior building envelope conform to performance requirements specified herein.

1. The test shall be performed when the building envelope is enclosed and prior to the installation of finishes, including gypsum board.
2. Notify the Architect at least 48 hours prior to the Building Air Tightness Test. A representative of the Architect will witness the test and record test readings.
3. Prior to the test, submit evidence that the test equipment has been calibrated within the past two years.
4. The measuring instruments used in the tests shall be digital meters, not analog gages. Tests shall be performed when the wind speed is less than 10 mph, and no rain.
5. The following conditions will be observed in the building during the testing:
 - a. Exterior doors and windows shall be closed.
 - b. Interior doorways including stairway doors shall be open.
 - c. HVAC systems shall be de-energized.
 - d. Appliances shall be de-energized.
 - e. Plumbing traps shall be primed.
 - f. Follow the Recommended Test Envelope conditions in ASTM E1827, Table 1, for the Closed Envelope condition.
 - g. Test the building air leakage rate by pressurizing the building relative to the exterior environment at twelve pressures up to at least 0.30 inches water gauge (1.57 psf or 75 Pa) and record the results at each step in pressure increase.
 - h. Test the building air leakage rate by depressurizing the building negatively relative to the exterior environment at twelve pressures up to at least -0.30 inches water gauge (1.57 psf or -75 Pa) and record the results; compare the results to the positive test.
 - 1) Where differences of 10% or more exist between the positive and negative pressure tests, investigate the causes and correct/resolve the reasons for the differences and then retest the building.
 - i. If the building fails to meet the acceptable leakage rate specified under performance criteria herein, use techniques described in ASTM E1186 to locate the leak sources, then correct the deficiencies in the building construction, then retest.
 - 1) Fog/smoke agents used to identify leaks shall be the non-toxic type.
 - j. For each test, take a minimum of 12 readings at various pressures and air flows within the range of the calibrated equipment.

- 1) In the test report, test points shall be shown in graphical form on a log-log scale with pressure in inches water column displayed on the horizontal axis and flow in cfm displayed on the vertical axis.
- 2) The results of each test conducted shall be included in the report whether successful or not.

3.04 THERMOGRAPHY INSPECTION

- A. While the airtightness testing is being conducted and building is being positively or negatively pressurized, the building envelope shall be inspected by a qualified Thermographer using an infrared camera conforming to requirements specified herein.
 1. Any areas where evidence of air leakage is observed coming through the building envelope shall be noted and both standard and infrared photos taken to record the location/condition. Use smoke tracer to positively confirm sources of air leakage.
- B. Report: Include a summary of the areas/conditions where air leakage was observed in the building envelope along with the standard and infrared photo images taken.
- C. In the event that the building exceeds the specified air leakage rate, the building envelope shall be inspected by the Thermographer during each subsequent airtightness test that is conducted and shall be used to demonstrate and provide digital infrared photo record showing that the areas of air leakage have been corrected.

3.05 REPAIR AND PROTECTION

- A. Take measures to protect the air barrier system from damage during construction.
- B. Damaged air barriers shall be repaired as recommended by manufacturer by the air barrier installer prior to cover.
- C. After completion of the building and upon completion of inspection and testing, restore/repair any removed/damaged construction caused by finding and repairing leaks in the air barrier system and restore substrates, insulation and finishes to their original condition.

END OF SECTION 07 08 10

SECTION 07 21 00
THERMAL INSULATION - ROCKWOOL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mineral fiber board insulation.
- B. Mineral fiber blanket insulation.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Metal stud walls.
- B. Section 06 10 00 - Rough Carpentry: Wall sheathing.

1.03 REFERENCE STANDARDS

- A. ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations; 2007 (Reapproved 2017).
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- C. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- F. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- I. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- M. EN 15804 - Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products; 2014.
- N. ILFI (DEC) - International Living Future Institute 'Declare' Program; 2017.
- O. ISO 14025 - Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures; 2006.
- P. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.
- Q. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

- B. Deliver materials and accessories in insulation manufacturer's original packaging with identification labels intact and in sizes to suit project.
 - 1. Ensure insulation materials are not exposed to moisture during delivery.
 - 2. Replace wet or damaged insulation materials.
- C. Store materials off ground in dry location and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer; store in original packaging until installed.
- D. Packaging Waste Management: Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling.

1.07 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermal Insulation:
 - 1. ROCKWOOL: www.rockwool.com/#sle.

2.02 MINERAL FIBER BOARD INSULATION MATERIALS

- A. Type ____ - Mineral Fiber Board Thermal Insulation: Semi-rigid stone wool insulation that is noncombustible; Type IVB in accordance with ASTM C612.
 - 1. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
 - 2. Smoke Developed Index (SDI): 50 or less, when tested in accordance with ASTM E84 or UL 723.
 - 3. Facing: Unfaced.
 - 4. Board Thickness: 1 inch.
 - 5. Board Size: 24 by 48 inches.
 - 6. Board Edges: Square.
 - 7. Thermal Resistance: R-value of 4.3 per 1 inch at 75 degrees F, minimum, when tested in accordance with ASTM C518 or ASTM C177.

8. Noise Reduction Coefficient (NRC): Not less than 1.0 for 2 inches (51 mm) thick when measured and calculated in accordance with ASTM C423.
9. Monolithic Density (2 inches or Less Thickness): 4.3 pcf, nominal.
10. Moisture Resistance: Absorption of less than 0.03 percent by volume.
11. Water Vapor Permeance: 27 perm, maximum, at 1 inch thick when tested in accordance with ASTM E96/E96M, desiccant method.
12. Metallic Corrosion Resistance: Noncorrosive/passed, when tested in accordance with ASTM C665 for steel, and ASTM C795 for stress corrosion cracking tendency of austenitic stainless steel.
13. Melting Point: 2,150 degrees F, minimum.
14. Fungi Resistance: Zero mold growth when tested in accordance with ASTM C1338.
15. Environmental Product Declaration (EPD): Material included on UL-certified EPD in accordance with EN 15804 and ISO 14025; see 01 60 00 - Product Requirements for additional information.
16. Products:
 - a. ROCKWOOL; CAVITYROCK: www.rockwool.com/#sle.

2.03 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Type ____ - Mineral Fiber Blanket Thermal Insulation: Semi-rigid stone wool insulation that is noncombustible; Type 1 in accordance with ASTM C665.
 1. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
 2. Smoke Developed Index (SDI): 50 or less, when tested in accordance with ASTM E84 or UL 723.
 3. Facing: Unfaced.
 4. Steel Studs: See Section 05 40 00.
 - a. Blanket Overall Size: 3-1/2 inches thick by 16-1/4 inches wide by 48 inches long, nominal.
 - b. Thermal Resistance: R-value of 15 at 75 degrees F, minimum, when tested in accordance with ASTM C518.
 5. Board Edges: Square.
 6. Density: Greater than 2 pcf, nominal.

7. Moisture Resistance: Absorption of less than 0.03 percent by weight.
8. Metallic Corrosion Resistance: Noncorrosive/passed, when tested in accordance with ASTM C665 for steel, and ASTM C795 for stress corrosion cracking tendency of austenitic stainless steel.
9. Melting Point: 2,150 degrees F, minimum.
10. Fungi Resistance: Zero mold growth when tested in accordance with ASTM C1338.
11. Environmental Product Declaration (EPD): Material included on UL-certified EPD in accordance with EN 15804 and ISO 14025; see 01 60 00 - Product Requirements for additional information.
12. Low-Emitting VOC Material Certification: Greenguard Gold certified and listed in UL (GGG).
13. Products:
 - a. ROCKWOOL; COMFORTBATT: www.rockwool.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycombs, fins, or irregularities.

3.02 INSTALLATION

- A. Install insulation in accordance with manufacturer's written installation instructions.
- B. Ensure that insulation installation maintains continuity of thermal protection to building interior spaces.
- C. Do not compress insulation to fit into spaces.

3.03 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00

SECTION 07 25 00
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water-resistive barriers.

1.02 RELATED REQUIREMENTS

- A. Section 06 16 43 - GYPSUM SHEATHING.
- B. Section 07 08 10 - BUILDING AIRTIGHTNESS REQUIREMENTS.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- D. Section 07 92 00 - Joint Sealants: Sealant materials and installation techniques.

1.03 DEFINITIONS

- A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

1.04 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.05 SUBMITTALS

- A. Product Data: Provide data on material characteristics.
- B. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. Exterior Air Barrier and Vapor Retarder: Provide on exterior walls under exterior cladding.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Membrane:

1. Air Permeance: 0.008 L/(sec-m²), maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B (Water Method) at 73.4 degrees F.
3. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to six months of weather exposure.
4. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
5. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
6. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
7. VOC Content: 100 g per L or less.
8. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
9. Manufacturers:
 - a. Carlisle Coatings and Waterproofing, Inc; Fire Resist Barritech-VP: www.carlisleccw.com/#sle.
 - b. GCP Applied Technologies; Perm-A-Barrier VPL: www.gcpat.com/#sle.
 - c. Henry Company; Air-Bloc 33MR: www.henry.com/#sle.
 - d. W.R. Meadows, Inc; Air-Shield LMP: www.wrmeadows.com/#sle.

2.03 SEALANTS

- A. Joint Sealants: Specified in Section 07 92 00.

- B. Detailing and Termination Sealant: Manufacturer's standard bituthene liquid membrane; two-part, elastomeric trowel grade.

2.04 ACCESSORIES

- A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.
- B. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and weather barrier materials.
- C. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
 - 1. Width: 4 inches.
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 180 days of weather exposure.
- D. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
 - 1. Width: 3-1/2 inches.
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 180 days of weather exposure.
- E. Preformed Transition Membrane: Semi-rigid silicone or polyester composition, tapered edges, and tear resistant.
- F. Liquid Flashing: One part, fast curing, nonsag, elastomeric, gun grade, trowelable liquid flashing.
- G. Primers: Manufacturer's standard water-based primer.
- H. Thinners and Cleaners: As recommended by water-resistive barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.
Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

- B. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions.
Provide clean, dust-free, and dry substrate for air barrier application.
- C. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.
- D. 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 air barrier.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Coatings:
 - 1. Prepare substrate in accordance with coating manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
 - 2. Where exterior masonry veneer is being applied, install masonry anchors prior to placement of water-resistive barrier over masonry substrate; seal airtight around anchors.
 - 3. Apply flashing to seal with adjacent construction and to bridge joints in coating substrate.
- C. Openings and Penetrations in Exterior Water-Resistive Barriers:
 - 1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches onto water-resistive barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 - 2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
 - 3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
 - 4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches beyond face of jambs; seal water-resistive barrier to flashing.
 - 5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
 - 6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.04 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 07 25 00

SECTION 07 46 46
FIBER-CEMENT SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiber-cement siding.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Siding substrate framing.
- B. Section 06 16 43 - GYPSUM SHEATHING: Siding substrate.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barrier under siding.
- D. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.
- E. Section 09 91 13 - Exterior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- D. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets; 2022.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods, including nail patterns.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.
- C. Manufacturer's qualification statement.

- D. Installer's qualification statement.
- E. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.
- F. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified in this section with not less than three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- A. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.
- B. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

1.07 FIELD CONDITIONS

- A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.08 WARRANTY

- A. Manufacturer Warranty: Provide manufacturer warranty for years as indicated under Fiber-Cement Siding article sub-headings for "Warranty". Complete forms in Owner's name and register with manufacturer.
- B. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) shall provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore to watertight conditions.

PART 2 PRODUCTS

2.01 FIBER-CEMENT SIDING

- A. Lap Siding: Individual horizontal boards (installed vertically) made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Style: V-groove.
 - 2. Texture: Smooth.
 - 3. Length: 12 feet, nominal.
 - 4. Width (Height): 8-1/4 inches.
 - 5. Thickness: 0.625 inch, nominal.
 - 6. Finish: Unfinished.
 - 7. Color: As selected by Architect from manufacturers full range of available colors.
 - 8. Warranty: 50 year limited; transferable.
 - 9. Products:
 - a. James Hardie Building Products, Inc; Hardie Artisan Siding:
www.jameshardie.com/#sle.
- B. Panel Siding: Vertically oriented panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Texture: Smooth.
 - 2. Length (Height): 96 inches, nominal.
 - 3. Width: 48 inches.
 - 4. Thickness: 5/16 inch, nominal.
 - 5. Finish: Unfinished.
 - 6. Color: As selected by Architect from manufacturers full range of available colors.
 - 7. Warranty: 50 year limited; transferable.
 - 8. Products:
 - a. James Hardie Building Products, Inc; Hardie Architectural Panel:
www.jameshardie.com/#sle.

- C. Soffit Panels: Panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Texture: Hardie Soffit Beaded Porch Panel.
 - 2. Length: 96 inches, nominal.
 - 3. Width: 48 inches.
 - 4. Thickness: 5/16 inch, nominal.
 - 5. Finish: Factory applied primer.
 - 6. Color: As selected by Architect from manufacturers full range of available colors.
 - 7. Manufacturer: Same as siding.

2.02 ACCESSORIES

- A. Cladding Support Clips: Thermally-broken, galvanized steel clips for support of cladding z-girts, angles, channels and other framing.
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 galvanized coating.
- B. Trim: _____.
- C. Metal Trim: Extruded aluminum alloy 6063-T5 temper.
 - 1. Finish: Clear anodized.
 - 2. Vertical Profile Trim:
 - a. Type: As indicated on drawings.
 - 3. Horizontal Profile Trim:
 - a. Type: As indicated on drawings.
 - 4. Termination Profile Trim:
 - a. Type: As indicated on drawings.
 - 5. Outside Corner Trim:
 - a. Type: _____.
- D. Fasteners: Galvanized or corrosion resistant; length as required to penetrate, 1-1/4 inches, minimum.

- E. Exterior Soffit Vents: One piece, perforated, ASTM B221 (ASTM B221M), 6063 alloy, T5 temper, aluminum, with flat panel edge and manufactured especially for soffit application, and provide continuous vent.
- F. Joint Sealer: As specified in Section 07 92 00 - Joint Sealants.
- G. Field Finishing: As specified in Section 09 91 13 - Exterior Painting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.

3.02 PREPARATION

- A. Protect surrounding areas and adjacent surfaces during execution of this work.
- B. Install Sheet Metal Flashing:
 - 1. Above door and window trim and casings.
 - 2. Above horizontal trim in field of siding.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
 - 1. Read warranty and comply with terms necessary to maintain warranty coverage.
 - 2. Use trim details as indicated on drawings.
 - 3. Touch up field cut edges before installing.
 - 4. Pre-drill nail holes if necessary to prevent breakage.
- B. Over Steel Studs: Use hot-dipped galvanized self-tapping screws, with the points of at least three screws penetrating each stud the panel crosses and at panel ends.
- C. Allow space for thermal movement between both ends of siding panels that butt against trim; seal joint between panel and trim with specified sealant.
- D. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
- E. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.
- F. Do not install siding less than 6 inches from ground surface, or closer than 1 inch to roofs, patios, porches, and other surfaces where water may collect.

- G. Exterior Soffit Vents: Install in accordance with manufacturer's written instructions and at locations indicated on drawings; provide vent area as indicated on drawings.
- H. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.
- I. Finish Painting: See Section 09 91 13.

3.04 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 46 46

SECTION 07 52 16
STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS ROOFING (SBS)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. SBS modified bituminous membrane roofing system, including all components specified.
- B. Manufactured metal roof edging and copings.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers associated with roofing and roof insulation.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Formed metal flashing and trim items associated with roofing.
- C. Section 07 71 00 - Roof Specialties: Manufactured copings, fascias, gravel stops, and other flashing-related items.
- D. Section 07 72 00 - Roof Accessories: Roof hatches, vents, and manufactured curbs.
- E. Division 22 Sections: For plumbing specialties and roof drains.

1.03 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 for definition of terms related to roofing work not otherwise defined in the section.
- B. LTTR: Long Term Thermal Resistance, as defined by CAN-ULC S770.

1.04 REFERENCE STANDARDS

- A. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2013.
- B. ASTM C728 - Standard Specification for Perlite Thermal Insulation Board; 2013.
- C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- E. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011.
- F. ASTM D1079 - Standard Terminology Relating to Roofing, Waterproofing, and Bituminous Materials; 2013.

- G. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- H. ASTM D6163 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements; 2000 (Reapproved 2008).
- I. ASTM D6164/D6164M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements; 2011.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- K. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
- L. FM DS 1-28 - Wind Design; Factory Mutual System; 2007.
- M. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.
- N. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2003. (ANSI/SPRI ES-1)

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference: Before start of roofing work, Contractor shall hold a meeting to discuss the proper installation of materials and requirements to achieve the warranty.
 - 1. Require attendance with all parties directly influencing the quality of roofing work or affected by the performance of roofing work.
 - 2. Notify Architect well in advance of meeting.

1.06 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site within one week of roofing application.
 - 1. Verify readiness of the project structure.
 - 2. Review any changes or corrections to details.
 - 3. Review anticipated schedule of progress.
- B. Final Inspection Conference: Conduct conference at Project site just before roofing work is complete.
 - 1. With attendees from Preinstallation Conference, walk the complete roof.
 - 2. Establish final punch list items.

3. Review summary of project records.
4. Review recommended maintenance program.
5. Review roof protection strategy through final completion.
6. Review requirements of final acceptance, including submission of fully executed guarantees.

1.07 SUBMITTALS

A. Product Data:

1. Provide membrane manufacturer's printed data sufficient to show that all components of roofing system, including insulation and fasteners, comply with the specified requirements and with the membrane manufacturer's requirements and recommendations for the system type specified; include data for each product used in conjunction with roofing membrane.
 - a. Include documentation indicating that roof materials comply with Solar Reflectance Index requirement.
2. Where UL or FM requirements are specified, provide documentation that shows that the roofing system to be installed is UL-Classified or FM-approved, as applicable; include data itemizing the components of the classified or approved system.
3. Installation Instructions: Provide manufacturer's instructions to installer, marked up to show exactly how all components will be installed; where instructions allow installation options, clearly indicate which option will be used.

B. Samples: Submit samples of each product to be used.

C. Shop Drawings: Provide:

1. The roof membrane manufacturer's standard details customized for this project for all relevant conditions, including flashings, base tie-ins, roof edges, terminations, expansion joints, penetrations, and drains.
2. For tapered insulation, provide project-specific layout and dimensions for each board.

D. Specimen Warranty: Submit prior to starting work.

E. Installer Qualifications: Letter from manufacturer attesting that the roofing installer meets the specified qualifications.

F. Pre-Installation Notice: Copy to show that manufacturer's required Pre Installation Notice (PIN) has been accepted and approved by the manufacturer.

G. Executed Warranty.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Roofing installer shall have the following:
 - 1. Current approval, license, or authorization as applicator by the manufacturer.
 - 2. Fully staffed office within 100 miles of the job site.
 - 3. At least five years experience in installing specified system.
- B. Comply with the published recommendations and instructions of the roofing membrane manufacturer.
- C. Commencement of work by Contractor shall constitute acknowledgement by Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer. No modification of the Contract Sum will be made for failure to adequately examine the Contract Documents or the project conditions.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.
- B. Store materials clear of ground and moisture with weather protective covering.
- C. Keep combustible materials away from ignition sources.

1.10 WARRANTY

- A. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
- B. Metal Roof Edging: Full-system warranty for roof edge system, covering blow-off from winds up to 150 mph.
- C. Metal Roof Edging with Exposed Decorative Fascia: Provide 20 year warranty for painted finish covering color fade, chalk, and film integrity.
- D. Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special System Warranty includes; membrane roofing, membrane flashings, liquid flashings, roof insulation, insulation adhesives or fasteners, metal flashing components, and roofing accessories and other components of the membrane roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Siplast; Specification Plate 2030FR IT: www.siplast.com.
- B. Other Acceptable Manufacturers:
 - 1. Firestone Building Products Co.; SBS Premium FR Torch System: www.firestonebpco.com.
 - 2. Johns Manville Corporation; DynaGlas System: www.jm.com.
 - 3. Soprema, Inc.; Sopralene System: www.soprema.us.
- C. Manufacturer of Insulation: Same manufacturer as roof membrane.
- D. Manufacturer of Metal Roof Edging: Same manufacturer as roof membrane.
 - 1. Metal roof edging products by other manufacturers are not acceptable.
 - 2. Field- or shop-fabricated metal roof edgings are not acceptable.

2.02 ROOFING SYSTEM DESCRIPTION

- A. Roofing System: Styrene-butadiene-styrene modified bituminous membrane.
 - 1. Membrane and Attachment: Mineral granule surfaced cap sheet and base sheet, heat welded (torch applied).
 - 2. Granule Color: White.
 - 3. Warranty: Full system warranty; 20 year Limited Warranty covering membrane, roof insulation, metal roof edging and membrane accessories.
 - 4. Slope: Deck is flat, provide slope of 1/8 inch per foot by means of tapered insulation.
 - 5. Comply with applicable local building code requirements.
 - 6. Provide assembly having Underwriters Laboratories, Inc. (UL) Class A Fire Hazard Classification.
 - 7. Provide assembly complying with Factory Mutual Corporation (FM) Roof Assembly Classification, FM DS 1-28 and 1-29, and meeting minimum requirements of FM 1-90 wind uplift rating.
- B. Roofing System Components:
 - 1. Cap sheet
 - 2. Interply base sheet(s).

3. Insulation Cover Board: Gypsum-based board, 1/2 inch thick; mechanically fastened.
4. Insulation:
 - a. Maximum Board Thickness: 1.5 inches; use as many layers as necessary; stagger joints in adjacent layers.
 - b. Tapered: Slope as indicated; provide minimum R-value at thinnest point; place tapered layer on top.
 - c. Total R Value: 25, average.
 - d. Maximum Thickness: 6 inches.
 - e. Top Layer: Polyisocyanurate foam board, non-composite; mechanically fastened.
 - f. Intermediate Layer(s), If Any: Polyisocyanurate foam board, non-composite; mechanically fastened.
 - g. Bottom Layer: Polyisocyanurate foam board, non-composite; mechanically fastened.
 - h. Crickets: Tapered insulation of same type as specified for top layer; slope as indicated.

2.03 SBS MODIFIED BITUMEN MATERIALS

- A. Cap Sheet: Granule surfaced SBS polymer-modified bitumen sheet, reinforced with non-woven polyester fabric, complying with ASTM D6163/D6163M, Type I, Grade G, with the following additional characteristics:
 1. Formulated for torch application.
 2. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
 3. Basis of Design Product: Paradiene 30 CR FR TG by Siplast.
- B. Interply Base Sheet: Torch grade SBS polymer-modified bitumen sheet, reinforced with non-woven fabric, complying with ASTM D6163, Type I, Grade S, formulated for torch application to substrate and cap sheet, and with the following additional characteristics:
 1. Basis of Design Product: Paradiene 20 TG by Siplast.
- C. Base Sheet: Same as interply base sheet.
- D. Aluminum Faced Flashing: SBS rubber modified asphalt membrane, reinforced with glass fiber scrim/mat composite, and clad with embossed aluminum foil, for heat welded application.
 1. Basis of Design Product: Veral Aluminum Foil Flashing by Siplast.

2.04 ASPHALT ROOFING MATERIALS

- A. Asphalt Primer: ASTM D41/D41M, suitable for use on concrete and insulation substrates.
- B. Liquid Flashings: Catalyzed acrylic resin combined with non-woven polyester fleece.
 - 1. Basis of Design Product: Parapro 123 Flashing System by Siplast.
- C. Flashing Cement: Asphalt-based, asbestos-free, complying with ASTM D4586.
- D. Roof Walkway Pads: Granule surfaced SBS polymer-modified cap sheet.

2.05 ROOF INSULATION AND COVER BOARDS

- A. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam with black glass reinforced mat laminated to faces, complying with ASTM C1289 Type II Class 1, with the following additional characteristics:
 - 1. Thickness: As indicated elsewhere.
 - 2. Size: 48 inches by 96 inches, nominal.
 - 3. R-Value (LTTR):
 - a. 1.5 inch Thickness: 8.5, minimum.
 - 4. Compressive Strength: 20 psi when tested in accordance with ASTM C1289.
 - 5. UL-Classified and FM-approved for direct to steel deck applications.
 - 6. Basis of Design Product: Paratherm by Siplast.
- B. Gypsum-Based Cover Board: Non-combustible, water resistant gypsum core with embedded glass mat facers, complying with ASTM C1177/C1177M, and with the following additional characteristics:
 - 1. Size: 48 inches by 96 inches, nominal.
 - 2. Thickness: As indicated elsewhere.
 - 3. Surface Water Absorption: 2.5 g, maximum, when tested in accordance with ASTM C473.
 - 4. Spanning Capability: Recommended by manufacturer for following minimum flute spans:
 - a. 1/2 inch Thickness: 5 inches, minimum.
 - 5. Surface Burning Characteristics: Flame spread of 0, smoke developed of 0, when tested in accordance with ASTM E84.
 - 6. Combustibility: Non-combustible, when tested in accordance with ASTM E136.

7. Factory Mutual approved for use with FM 1-60 and 1-90 rated roofing assemblies.
 8. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D3273 for minimum of 4 weeks.
 9. Basis of Design Product: Georgia-Pacific; DensDeck Prime Roof Guard: www.gp.com.
- C. Insulation Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.
- D. Adhesive for Insulation Attachment: Type as required by roof membrane manufacturer for roofing system and warranty to be provided; use only adhesives furnished by roof membrane manufacturer.

2.06 METAL ACCESSORIES

- A. Metal Roof Edging and Fascia: Continuous metal edge member serving as termination of roof membrane and retainer for metal fascia; watertight with no exposed fasteners; mounted to roof edge nailer.
1. Wind Performance:
 - a. Membrane Pull-Off Resistance: 100 lbs/ft, minimum, when tested in accordance with ANSI/SPRI ES-1 Test Method RE-1, current edition.
 - b. Fascia Pull-Off Resistance: At least the minimum required when tested in accordance with ANSI/SPRI ES-1 Test Method RE-2, current edition.
 - c. Provide product listed in current Factory Mutual Research Corporation Approval Guide with at least FM 1-270 rating.
 2. Description: Two-piece; extruded aluminum T-shaped edge member securing top and bottom edges of flat-faced formed metal fascia.
 - a. Basis of Design Product: Paraguard M by Siplast.
 3. Fascia Face Height: 5 inches or as indicated on the drawings.
 4. Edge Member Height Above Nailer: 1-1/4 inches.
 5. Fascia Material and Finish: 0.040 inch thick formed aluminum, Kynar 500 finish in manufacturer's standard color; matching concealed joint splice plates; factory-installed protective plastic film.
 6. Length: 144 inches.
 7. Functional Characteristics: Fascia retainer supports while allowing for free thermal cycling of fascia.

8. Aluminum Bar: Continuous 6063-T6 alloy aluminum extrusion with pre-punched slotted holes; miters welded; injection molded EPDM splices to allow thermal expansion.
 9. Anchor Bar Cleat: 20 gage, 0.036 inch G90 coated commercial type galvanized steel with pre-punched holes.
 10. Fasteners: Factory-provided corrosion resistant fasteners, with drivers; no exposed fasteners permitted.
 11. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, scuppers, and end caps; minimum 14 inch long legs on corner pieces.
 12. Scuppers: Welded watertight.
 13. Accessories: Provide matching brick wall cap, downspout, extenders, and other special fabrications as shown on the drawings.
- B. Parapet Copings: Formed metal coping with galvanized steel anchor/support cleats for capping any parapet wall; watertight, maintenance free, without exposed fasteners; butt type joints with concealed splice plates; mechanically fastened as indicated;
1. Wind Performance:
 - a. At least the minimum required when tested in accordance with ANSI/SPRI ES-1 Test Method RE-3, current edition.
 - b. Provide product listed in current Factory Mutual Research Corporation Approval Guide with at least FM 1-90 rating.
 2. Description: Coping sections allowed to expand and contract freely while locked in place on anchor cleats by mechanical pressure from hardened stainless steel springs factory attached to anchor cleats; 8 inch wide splice plates with factory applied dual non-curing sealant strips capable of providing watertight seal.
 - a. Basis of Design Product: Paraguard M by Siplast.
 3. Material and Finish: Minimum 0.050 inch thick formed aluminum, Kynar 500 finish in custom color; matching concealed joint splice plates; factory-installed protective plastic film.
 4. Dimensions:
 - a. Wall Width: As indicated on the drawings.
 - b. Piece Length: 120 inches or length used in achieving certification, whichever is greater.

5. Anchor/Support Cleats: 20 gage, 0.036 inch thick prepunched galvanized cleat with 12 inch wide stainless steel spring mechanically locked to cleat at 72 inches on center.
6. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, corners, intersections, curves, pier caps, and end caps; minimum 14 inch long legs on corner, intersection, and end pieces.
7. Fasteners: Factory-furnished; electrolytically compatible; minimum pull out resistance of 240 pounds for actual substrate used; no exposed fasteners.

2.07 ACCESSORY MATERIALS

- A. Cant Strips and Tapered Edge Strips: 45 degree face slope and minimum 5 inch face dimension; provide at all angle changes between vertical and horizontal planes that exceed 45 degrees.
 1. Type: Non-flammable perlite, complying with ASTM C728.
 2. Install using hot asphalt (Type IV), roofing mastic, or mechanically fastened using fasteners and plates approved by roofing manufacturer.
- B. Concrete Pavers: Interlocking, with shiplap edges on all sides and integral radiused bearing pads.
 1. Size: Approximately 12 inches by 16 inches by 1-1/2 inches thick.
 2. Weight Per Unit Surface Area: 12 lbs per square foot, nominal.
 3. Weight Tolerance: Plus/minus 0.75 pounds per square foot, maximum, when tested in accordance with ASTM C140/C140M.
 4. Density: 125 pounds per cubic foot, nominal.
 5. Compressive Strength: 5000 psi, nominal.
 6. Water Absorption: 5 percent, nominal.
 7. Manufacturer: Same as roofing membrane.

PART 3 INSTALLATION

3.01 GENERAL

- A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.
- B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.

- C. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.
- D. Perform work using competent and properly equipped personnel.
- E. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.
- F. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F.
- G. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
 - 1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
 - 2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
 - 3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.
- H. Until ready for use, keep materials in their original containers as labeled by the manufacturer.
- I. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.02 EXAMINATION

- A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.
- B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.
- C. Examine roof substrate to verify that it is properly sloped to drains.
- D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.
- E. Verify that wood nailers have been properly installed.

3.03 PREPARATION

- A. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.
- B. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.
- C. Fill all surface voids in the immediate substrate that are greater than 1/4 inch wide with fill material acceptable insulation to membrane manufacturer.
- D. Seal, grout, or tape deck joints, where needed, to prevent bitumen seepage into building.
- E. Wood Nailers: Provide wood nailers at all perimeters and other locations where indicated on the drawings, of total height matching the total thickness of insulation being used.
 - 1. Install with 1/8 inch gap between each length and at each change of direction.
 - 2. Mechanically fasten to deck to resist force of 200 lbf per linear foot.

3.04 INSULATION AND COVER BOARD INSTALLATION

- A. Install insulation in configuration and with attachment method(s) specified in PART 2, under Roofing System.
- B. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.
- C. Lay roof insulation in courses parallel to roof edges.
- D. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch. Fill gaps greater than 1/4 inch with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch.
- E. Mechanical Fastening: Using specified fasteners and insulation plates engage fasteners through insulation into deck to depth and in pattern required by Factory Mutual for FM Class specified in PART 2 and membrane manufacturer, whichever is more stringent.

3.05 MODIFIED BITUMEN INSTALLATION BY HEAT WELDING (TORCH)

- A. Start at the low point with a full width sheet, fully unrolled and aligned; align and unroll remaining sheets during heat fusing operation.
- B. Fully heat weld sheets to substrate using methods recommended by roof membrane manufacturer.
- C. Maintain 3 inch side laps and 6 inch end laps.

- D. Granule Surfaced Sheets: In areas that form the substrate for heat fusing, such as laps, flashings, and patches, embed the granules prior to fusing subsequent sheet. Apply additional granules to all exposed surfaces that have none or cover with additional piece of granule surfaced material.
- E. Complete the entire membrane installation without undue delay.

3.06 FLASHING AND ACCESSORIES INSTALLATION

- A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.
- B. Metal Accessories: Install metal edgings, gravel stops, and copings in locations indicated on the drawings, with horizontal leg of edge member over membrane and flashing over metal onto membrane.
 - 1. Follow roofing manufacturer's instructions.
 - 2. Remove protective plastic surface film immediately before installation.
 - 3. Install water block sealant under the membrane anchorage leg.
 - 4. Flash with manufacturer's recommended flashing sheet unless otherwise indicated.
 - 5. Where single application of flashing will not completely cover the metal flange, install additional piece of flashing to cover the metal edge.
 - 6. If the roof edge includes a gravel stop and sealant is not applied between the laps in the metal edging, install an additional piece of self-adhesive flashing membrane over the metal lap to the top of the gravel stop; apply seam edge treatment at the intersections of the two flashing sections.
 - 7. When the roof slope is greater than 1:12, apply seam edge treatment along the back edge of the flashing.
- C. Scuppers: Set in sealant and secure to structure; flash as recommended by manufacturer.
- D. Roofing Expansion Joints: Install as shown on drawings and as recommended by roofing manufacturer.
- E. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing membrane abuts to; extend flashing at least 8 inches high above membrane surface.
 - 1. Use the longest practical flashing pieces.
 - 2. Evaluate the substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.

3. Complete the splice between flashing and the main roof sheet with specified splice adhesive before adhering flashing to the vertical surface.
4. Provide termination directly to the vertical substrate as shown on roof drawings.

F. Roof Drains:

1. Taper insulation around drain to provide smooth transition from roof surface to drain. Use specified pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope; slope not to exceed manufacturer's recommendations.
2. Position membrane, then cut a hole for roof drain to allow 1/2 to 3/4 inch of membrane to extend inside clamping ring past drain bolts.
3. Make round holes in membrane to align with clamping bolts; do not cut membrane back to bolt holes.
4. Apply sealant on top of drain bowl where clamping ring seats below the membrane.
5. Install roof drain clamping ring and clamping bolts; tighten clamping bolts to achieve constant compression.

G. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.

1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.
2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches deep, with at least 1 inch clearance from penetration, sloped to shed water.
3. Structural Steel Tubing: If corner radii are greater than 1/4 inch and longest side of tube does not exceed 12 inches, flash as for pipes; otherwise, provide a standard curb with flashing.
4. Flexible and Moving Penetrations: Provide weathertight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.
5. High Temperature Surfaces: Where the in-service temperature is, or is expected to be, in excess of 180 degrees F, protect the elastomeric components from direct contact with the hot surfaces using an intermediate insulated sleeve as flashing substrate as recommended by membrane manufacturer.

3.07 FINISHING AND WALKWAY INSTALLATION

- A. Install walkways at access points to the roof, around rooftop equipment that may require maintenance, and where indicated on the drawings.
1. Use specified walkway pads unless otherwise indicated.

2. Do not install walkway pads within 10 feet of any roof edge or perimeter -- these areas require loose-laid pavers as walking surfaces.
- B. Walkway Pads: Adhere to the roofing membrane, spacing each pad at minimum of 1.0 inch and maximum of 3.0 inches from each other to allow for drainage.
1. If installation of walkway pads over field fabricated splices or within 6 inches of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6 inches on either side.
 2. Prime the membrane, remove the release paper on the pad, press in place, and walk on pad to ensure proper adhesion.
- C. Pavers: Install butted tightly, not more than 1/2 inch apart.
1. Pavers for Walkways: Prior to setting pavers, adhere an additional layer of roofing membrane over area where pavers will be laid, extending minimum of 2 inches beyond the paver.

3.08 FIELD QUALITY CONTROL

- A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).
- B. Perform all corrections necessary for issuance of warranty.

3.09 CLEANING

- A. Clean all contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings.
- B. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.
- C. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

3.10 PROTECTION

- A. Where construction traffic must continue over finished roof membrane, provide durable protection and replace or repair damaged roofing to original condition.

END OF SECTION 07 52 16

SECTION 07 54 23
THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. TPO Adhered membrane roofing system.
- B. Cover board.
- C. Roof insulation.

1.02 RELATED SECTIONS

- A. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, cants, curbs, blocking, and for wood-based, structural-use roof deck panels.
- B. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.
- C. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.03 REFERENCES

- A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:
 - 1. ASTM D 1079 "Terminology Relating to Roofing and Waterproofing."
 - 2. Glossary of NRCA's "The NRCA Roofing and Waterproofing Manual."
 - 3. Roof Consultants Institute "Glossary of Roofing Terms."
- B. Sheet Metal Terminology and Techniques: SMACNA "Architectural Sheet Metal Manual."

1.04 DESIGN CRITERIA

- A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- C. Wind Uplift Performance: Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.

1. Roof manufacturer's Registered Engineer shall calculate the up-lift pressures in accordance with IBC and ASCE 7 for the building's location.
 2. Assume 130 m.p.h. winds minimum.
 3. EPA Energy Star:
 - a. Roofing membrane shall achieve an initial reflectance of greater than 0.65 and a three year aged reflectance of greater than 0.50.
- D. Hail Resistance: MH.
- E. E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

1.05 SUBMITTALS

- A. Product Data: Manufacturer's data sheets for each product to be provided.
1. Include Manufacturer's documentation that the roofing system, as detailed and designed by the Manufacturer, will be able to resist the wind loads per IBC as developed using ASCE 07.
- B. Detail Shop Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:
1. Base flashings, cants, and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Crickets, saddles, and tapered edge strips, including slopes.
 4. Insulation fastening patterns.
- C. Verification Samples: Provide for each product specified.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Maintenance Data: Refer to Johns Manville's latest published documents on www.JM.com.
- F. Guarantees: Provide manufacturer's current guarantee specimen.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's guarantee.

1. Manufacturer Qualifications: Qualified manufacturer that has UL listing for roofing system identical to that used for this Project.
- B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E329.
- C. Test Reports:
 1. Roof drain and leader test or submit plumber's verification.
 2. Core cut (if requested).
 3. Roof deck fastener pullout test.
- D. Moisture Survey:
 1. Submit prior to installation, results of a non-destructive moisture test of roof system completed by approved third party. Utilize one of the approved methods:
 - a. Infrared Thermography
 - b. Nuclear Backscatter
- E. Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system must be labeled by the single source roofing manufacturer issuing the guarantee.
- F. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL or FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 1. If UL required, edit UL Fire requirements below.
 2. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
 3. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- 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.

- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. 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.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.09 GUARANTEE

- A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.
 - 1. Single-Source special guarantee includes roofing membrane, base flashings, liquid applied flashing, roofing membrane accessories, roof insulation, fasteners, cover board, newly installed substrate board, vapor retarder, walkway products, manufacturer's edge metal products, and other single-source components of roofing system marketed by the manufacturer.
 - 2. Guarantee Period: 20 years from date of Substantial Completion.
- B. Installer's Guarantee: Submit roofing Installer's guarantee, including all components of roofing system for the following guarantee period:
 - 1. Guarantee Period: Five Years from date of Substantial Completion.
 - 2. Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work.
 - a. Installer is responsible for coordinating with building owner's representative to verify compliance.

PART 2 PRODUCTS

2.01 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE - TPO

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced. Basis of Design: JM TPO
 - 1. Select one thickness in subparagraph below. Not all guarantee terms are available for all products, coordinate with Johns Manville Technical.
 - 2. Thickness: 60 mils (1.52 mm), nominal.

3. Exposed Face Color: White

2.02 AUXILIARY ROOFING MATERIALS - SINGLE PLY

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's internally reinforced or scrim reinforced, smooth backed membrane with same thickness and color as sheet membrane. Basis of Design: JM TPO.
- C. Bonding Adhesive: Manufacturer's standard solvent-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings. Basis of Design: JM TPO Low VOC Membrane Adhesive or JM TPO Membrane Adhesive (Solvent Based) as recommended by the Manufacturer.
- D. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors. Basis of Design: JM Termination Systems.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer. Basis of Design: Extra High Load Fasteners and Plates.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, cover strips, and other accessories.
 1. Provide product as recommended by the roofing system Manufacturer and as show in the approved shop drawings by the roofing system Manufacturer.
 2. Basis of Design Product include but may not be limited to: JM TPO Pourable Sealer A & B, JM TPO Pipe Boots, JM TPO Universal Corners, JM TPO Edge Sealant, JM TPO T-Joint Patch, JM TPO Membrane Cleaner, JM TPO Membrane Primer, JM TPO Membrane Primer (Low VOC), JM TPO Sealing Mastic, JM TPO Cover Tape, JM TPO Detail Membrane, JM TPO Peel & Stick 10" RPS, JM TPO Peel & Stick 6" RTS, JM TPO-Coated Metal, JM TPO Detail Membrane, and JM Single Ply Caulk.

2.03 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads sourced from membrane roofing system manufacturer. Basis of Design: JM TPO Walkpad.

2.04 COVER BOARD

- A. Perlite Board: ASTM C 728, Type 3; composed of expanded perlite, cellulosic fibers, binders and waterproofing agents with top surface seal-coated. Basis of Design: RetroPlus Roof Board.

2.05 ROOF INSULATION

- A. General: Preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class [1] [2] [3], Grade 3 (25 psi), Basis of Design: [ENRGY 3] [ENRGY 3 25 PSI] [ENRGY 3 CGF] [ENRGY 3 25 PSI CGF] [ENRGY 3 AGF] [ENRGY 3 25 PSI AGF] [ENRGY 3 FR] [ENRGY 3 25 PSI FR]
 - 1. Provide insulation package with minimum R Value: minimum required by applicable code.
 - 2. Provide insulation package with minimum thickness: 2 inches.
 - 3. Provide insulation package in multiple layers.
 - 4. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.
 - a. Determined in accordance with CAN/ULC S770 at 75°F (24°C)

2.06 TAPERED INSULATION

- A. Tapered Insulation: ASTM C 1289, Type II, Class [1] [2] [3], Grade [2 (20 psi)] [3 (25 psi)], provide factory-tapered insulation boards fabricated to slope of [1/4 inch per 12 inches (1:48)] [Insert slope], unless otherwise indicated. Basis of Design: [Tapered ENRGY 3] [Tapered ENRGY 3 25 PSI] [Tapered ENRGY 3 CGF] [Tapered ENRGY 3 25 PSI CGF] [Tapered ENRGY 3 AGF] [Tapered ENRGY 3 25 PSI AGF] [Tapered ENRGY 3 FR] [Tapered ENRGY 3 25 PSI FR]

2.07 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. Basis of Design: [Diamondback Pre-Cut Cricket] [Diamondback Pre-Cut Miter] [Tapered Fesco Edge Strip]
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer. Basis of Design: UltraFast Fasteners and Plates.
- D. Urethane Adhesive: Manufacturer's two component polyurethane adhesive formulated to adhere insulation to substrate. Basis of Design: [JM Two-Part Urethane Insulation Adhesive]

(UIA)] [JM Green Two-Part Urethane Insulation Adhesive] [JM One-Step Foamable Adhesive]
[Roofing Systems Urethane Adhesive (RSUA)]

- E. One Part Urethane Adhesive: Manufacturer's one component polyurethane adhesive formulated to adhere insulation to substrate. Basis of Design: Urethane Insulation Adhesive.
- F. Wood Nailer Strips: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.
 - 1. General:
 - a. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - b. 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.
 - c. Ensure general rigidity and proper slope for drainage.
 - d. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
- B. Unacceptable panels should be brought to the attention of the General Contractor and Project Owner's Representative and must be corrected prior to installation of roofing system.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSULATION INSTALLATION

- A. Coordinate installation of roof system components so insulation and cover board is not exposed to precipitation or left exposed at the end of the workday.

- B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation boards with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with like material.
- E. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- F. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- H. Preliminarily Fastened Insulation for Mechanically Fastened Systems: Install insulation with fasteners at rate required by roofing system manufacturer or applicable authority, whichever is more stringent.
 - 1. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.
- I. Adhered Insulation: Install each layer of insulation and cover board and adhere to substrate as follows:
 - 1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer's instruction.
 - 2. Install each layer in a one-part urethane adhesive according to roofing system manufacturer's instruction.
 - 3. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.
- J. Loose Laid Insulation with Top Insulation Layer Mechanically Fastened: Loose lay insulation with staggered joints and secure top layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type to deck type.
 - 1. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.
- K. Mechanically Fastened with Subsequent Layers Adhered Insulation: Secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type to deck type.
 - 1. Fasten first layer to resist uplift pressure at corners, perimeter, and field of roof.
 - 2. Install subsequent layers in a two-part urethane adhesive according to roofing system manufacturer's instruction.

3. Install subsequent layers in a one-part urethane adhesive according to roofing system manufacturer's instruction.
 4. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.
- L. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 COVER BOARD INSTALLATION

- A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.
- C. Install cover board with long joints of cover board in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with cover board.
 1. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.
 1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- E. Preliminarily Fastened Insulation for Mechanically Fastened Systems: Install insulation with fasteners at rate required by roofing system manufacturer or applicable authority, whichever is more stringent.
- F. Adhered Cover Board: Adhere cover board to substrate as follows:
 1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer's instruction.
 2. Install each layer in a one-part urethane adhesive according to roofing system manufacturer's instruction.
 3. Install to resist uplift pressure at corners, perimeter, and field of roof.
- G. Mechanically Fastened Cover Board: Install each layer of cover board and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof cover board to deck type.
 1. Fasten to resist uplift pressure at corners, perimeter, and field of roof.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.05 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Where roof slope exceeds 1/2 inch per 12 inches (1:24), contact the membrane manufacturer for installation instructions regarding installation direction and backnailing.
- D. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
- E. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.
 - 1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation 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.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.06 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing in accordance with membrane roofing system manufacturer's written instructions.
 - 1. Unroll roofing membrane and allow to relax before installing.
 - 2. Install sheet in accordance with roofing system manufacturer's written instructions.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- D. Bonding Adhesive: Apply water-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and immediately install roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

- E. Urethane Membrane Adhesive for fleece backed membranes: Apply Urethane Adhesive to substrate at rate required by manufacturer and install fleece-backed roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- F. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - a. Remove and repair any unsatisfactory sections before proceeding with Work.
 - 3. Repair tears, voids, and lapped seams in roofing membrane that do not meet requirements.
- I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- J. Install roofing membrane and auxiliary materials to tie in to existing roofing.
- K. Proceed with installation only after unsatisfactory conditions have been corrected.

3.07 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Apply water-based bonding adhesive at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- D. Flash penetrations and field-formed inside and outside corners per manufacturer's installation instructions.
- E. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.08 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat-weld walkway products to substrate according to roofing system manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. A roof inspection is required by Johns Manville before issuance of Johns Manville Peak Advantage Guarantee.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's Registered Roof Observer (RRO) to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- D. Repair or remove and replace components of roofing system where test results or inspections indicate that they do 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.

3.10 PROTECTION AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period.
- 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 07 54 23 07 54 23

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and exterior penetrations.
- B. Sealants for joints within sheet metal fabrications.
- C. Precast concrete splash pads.

1.02 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM B32 - Standard Specification for Solder Metal; 2020.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2015a (Reapproved 2021).
- F. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- G. CDA A4050 - Copper in Architecture - Handbook; current edition.
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- B. Samples: Submit two samples 6 by 6 inch in size illustrating metal finish color.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Pre-Finished Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 18 gauge, 0.040 inch thick; plain finish shop pre-coated with silicone modified polyester coating.
 - 1. Fluoropolymer Coating: High performance organic powder coating, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected by Architect from manufacturer's full range of colors including metallic and exotic.

2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.03 GUTTERS AND DOWNSPOUTS

- A. Gutters: SMACNA (ASMM) Rectangular profile.
- B. Downspouts: Rectangular profile unless indicated otherwise in drawings.

- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
- D. Accessories: Profiled to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 - 2. Gutter Supports: Brackets.
 - 3. Downspout Supports: Brackets.
- E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.
- F. Downspout Boots: Cast iron.
- G. Downspout Extenders: Same material and finish as downspouts.
- H. Seal metal joints.

2.04 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Underlayment: ASTM D2178/D2178M, glass fiber roofing felt.
- C. Primer Type: Zinc chromate.
- D. Protective Backing Paint: Zinc molybdate alkyd.
- E. Concealed Sealants: Non-curing butyl sealant.
- F. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- G. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- H. Reglets: Surface-mounted type, galvanized steel; face and ends covered with plastic tape.
- I. Solder: ASTM B32, Alloy Grade - Sn50 (50/50).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

- A. Comply with drawing details.
- B. Insert flashings into reglets to form tight fit; secure in place with plastic wedges; seal flashings into reglets with sealant.
- C. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- D. Apply plastic cement compound between metal flashings and felt flashings.
- E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- F. Seal metal joints watertight.
- G. Secure gutters and downspouts in place with concealed fasteners.
- H. Slope gutters 1/4 inch per 10 feet, minimum.
- I. Connect downspouts to downspout boots, and grout connection watertight.
- J. Set splash pads under downspouts, and set in place with mastic.

END OF SECTION 07 62 00

SECTION 07 22 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured curbs, equipment rails, and pipe roller supports.
- B. Equipment rails.
- C. Roof penetrations mounting curbs.
- D. Roof hatches.
- E. Non-penetrating pedestals.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

1.04 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. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
- C. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 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.

1.06 WARRANTY

- A. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.02 ROOF CURBS

- A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
 - 1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings, HVAC units, exhaust fans, duct openings, and equipment supports.
 - 2. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation.
 - 3. Sheet Metal Material:
 - a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.
 - 1) Color: As selected by Architect from manufacturer's standard line of colors.
 - 4. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches.
 - 5. Provide layouts and configurations indicated on drawings.
- B. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
 - 1. Provide preservative treated wood nailers along top of curb.
 - 2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.

3. Height Above Finished Roof Surface: 8 inches, minimum.
- C. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
 1. Provide preservative treated wood nailers along top of rails.
 2. Height Above Finished Roof Surface: 8 inches, minimum.
- D. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.
 1. Height Above Finished Roof Surface: 8 inches, minimum.
- E. Pipe Roller Supports: Adjustable roller assembly of top strap, plated vertical rods, cast iron roller chairs, galvanized steel channel shell, base plate and counterflashing.

2.03 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
 1. Bilco Company; Thermally Broken Roof Hatch: www.bilco.com/#sle.
 2. Dur-Red Products: www.dur-red.com/#sle.
 3. Milcor, Inc: www.milcorinc.com/#sle.
 4. Nystrom, Inc: www.nystrom.com/#sle.
- B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 1. Style: Provide flat metal covers unless otherwise indicated.
 2. Mounting Substrate: Provide frames and curbs suitable for mounting on corrugated metal roof deck with insulation.
 3. Size: As indicated on drawings; single-leaf style unless otherwise indicated.
 4. For Ladder Access: Single leaf; 36 by 42 inches.
- C. Frames and 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 gauge, 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 surface of roof deck, minimum.

- D. Metal Covers: Flush, insulated, hollow metal construction.
 - 1. Capable of supporting 40 psf external live load and 20 psf internal uplift load.
 - 2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch thick, liner 0.04 inch thick.
 - 3. Insulation: 2 inches rigid polyisocyanurate.
 - 4. Gasket: EPDM, continuous around cover perimeter.
- E. 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: Heavy duty pintle 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.

2.04 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

- A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
 - 1. Design Loadings and Configurations: As required by applicable codes.
 - 2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
 - 3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - 5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.02 CLEANING

- A. Clean installed work to like-new condition.

3.03 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 07 72 00

SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- D. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. FM (AG) - FM Approval Guide; current edition.
- H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2017).
- I. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- J. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- K. UL (DIR) - Online Certifications Directory; Current Edition.
- L. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Installer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Verification of minimum three years experience installing work of this type.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
 - 2. Hilti, Inc: www.us.hilti.com/#sle.
 - 3. Nelson FireStop Products: www.nelsonfirestop.com/#sle.
 - 4. Specified Technologies Inc; ____: www.stifirestop.com/#sle.

5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.02 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- E. Fire Ratings: Refer to drawings for required systems and ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
- B. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
 - 2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 - 2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 84 00

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 08 80 00 - Glazing: Glazing sealants and accessories.
- B. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- C. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- J. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2017).
- K. SWRI (VAL) - SWR Institute Validated Products Directory; Current Edition.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
- B. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- C. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- E. Installation Plan: Submit at least four weeks prior to start of installation.
- F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- H. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- I. Installation Log: Submit filled-out log for each length or instance of sealant installed.
- J. Field Quality Control Log: Submit filled-out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.
- K. Executed warranty.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of experience.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Stain Testing: In accordance with ASTM C1248; required only for masonry substrates.
 - 4. Allow sufficient time for testing to avoid delaying the work.
 - 5. Deliver sufficient samples to manufacturer for testing.
 - 6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- D. Installation Plan: Include schedule of sealed joints, including the following:
 - 1. Joint width indicated in Contract Documents.
 - 2. Approximate date of installation, for evaluation of thermal movement influence.
 - 3. Installation Log Form: Include the following data fields, with known information filled out.
 - a. Unique identification of each length or instance of sealant installed.
 - b. Location on project.
 - c. Substrates.
 - d. Sealant used.
 - e. Primer to be used, or indicate no primer is used.
 - f. Size and actual backing material used.
 - g. Date of installation.
 - h. Actual joint width; provide space to indicate maximum and minimum width.
 - i. Air temperature.

- E. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
1. Identification of testing agency.
 2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Substrate; if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.
 - b. Test date.
 - c. Location on project.
 - d. Sealant used.
 - e. Test method used.
 - f. Date of installation of field sample to be tested.
 - g. Copy of test method documents.
 - h. Test results, modeled after the sample form in the test method document.
- F. Field Quality Control Plan:
1. Visual inspection of entire length of sealant joints.
 2. Nondestructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
 - b. If any failures occur in the first 10 linear feet, continue testing at 12 inches intervals at no extra cost to Owner.
 3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1,000 linear feet, and one test per 1,000 linear feet thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1,000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
 4. Field testing agency's qualifications.

5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- G. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
 2. Have a copy of the test method document available during tests.
 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- H. Nondestructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
1. Record results on Field Quality Control Log.
 2. Repair failed portions of joints.
- I. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inches long.
 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
 3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.
 4. Record results on Field Quality Control Log.
 5. Repair failed portions of joints.

- J. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or another applicable method as recommended by manufacturer.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nonsag Sealants:

1. Bostik Inc: www.bostik-us.com/#sle.
2. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
3. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
4. Pecora Corporation: www.pecora.com/#sle.
5. Sika Corporation: www.usa-sika.com/#sle.
6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
7. W.R. Meadows, Inc: www.wrmeadows.com/#sle.

- B. Self-Leveling Sealants:

1. Bostik Inc: www.bostik-us.com/#sle.
2. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
3. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
4. Pecora Corporation: www.pecora.com/#sle.
5. Sika Corporation: www.usa-sika.com/#sle.
6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
7. W.R. Meadows, Inc: www.wrmeadows.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to:
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated.
 - c. Other joints indicated below.

B. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

C. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content; see Section 01 61 16.

2.04 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.

2. Color: To be selected by Architect from manufacturer's standard range.
 3. Cure Type: Single-component, neutral moisture curing.
 4. Service Temperature Range: Minus 20 to 180 degrees F.
 5. Products:
 - a. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
 - b. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
 - c. Sika Corporation; Sikasil WS-290: www.usa.sika.com/#sle.
 - d. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
- B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
1. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 2. Color: To be selected by Architect from manufacturer's standard range.
 3. Service Temperature Range: Minus 40 to 180 degrees F.

2.05 SELF-LEVELING JOINT SEALANTS

2.06 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 - 3. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- D. Destructive Adhesion Testing: If there are any failures in first 1,000 linear feet, notify Architect immediately.
- E. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- F. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION 07 92 00

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 14 16 - Flush Wood Doors.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- D. Section 09 91 13 - Exterior Painting: Field painting.
- E. Section 09 91 23 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. HMMA: Hollow Metal Manufacturers Association.
- C. NAAMM: National Association of Architectural Metal Manufacturers.
- D. NFPA: National Fire Protection Association.
- E. SDI: Steel Door Institute.
- F. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2018.

- D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2020.
- E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- G. ANSI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swing Door Assemblies.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- J. 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; 2018a.
- K. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- L. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- N. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2016.
- O. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- P. ITS (DIR) - Directory of Listed Products; Current Edition.
- Q. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- R. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- S. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.
- T. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- V. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- W. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2019.

- X. UL (DIR) - Online Certifications Directory; Current Edition.
- Y. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Exterior hollow metal 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. Refer to the Structural Drawings for wind velocity, pressures and other design requirements.

2.02 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.

4. Steelcraft, an Allegion brand: www.allegion.com/#sle.

2.03 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvanized) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvanized) for corrosive locations.

- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.04 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 2. Core: Vertical steel stiffeners and foamed in place polyurethane.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 3. Door Thermal Resistance: R-Value of 8.7, minimum, for installed thickness of polyurethane.
 4. Door Thickness: 1-3/4 inches, nominal.
 5. Weatherstripping: Refer to Section 08 71 00.
- C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI A250.8 <> (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 2. Core: Vertical steel stiffeners and fiberglass insulation.
 3. Door Thickness: 1-3/4 inches, nominal.
- D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.

- b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
- c. Model 1 - Full Flush.
- d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
- e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
- 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - c. Attach fire rating label to each fire rated unit.
- 3. Core: Vertical steel stiffeners and mineral fiberboard.
- 4. Door Thickness: 1-3/4 inches, nominal.

2.05 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvanized) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
 - 2. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
 - 3. Weatherstripping: Separate, see Section 08 71 00.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
 - 1. Fire Rating: Same as door, labeled.
 - 2. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

- G. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
- J. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps.
 - 1. Electrical knock out boxes are required at door position switches, electric strikes, card readers and middle hinge locations for all exterior locations regardless of electrical hardware specified in Section 08 71 00.
 - 2. Provide electrical knock out boxes with 3/4-inch knockouts.
 - 3. Provide field installed conduit for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in Section 08 71 00. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.

2.06 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - 1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.07 ACCESSORIES

- A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
 - 1. Size: As indicated on drawings.
 - 2. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
 - 3. Metal Finish: Gray polyester powder coating.
 - 4. Glazing: 1/4 inch thick, tempered glass, in compliance with requirements of authorities having jurisdiction.
 - a. In fire-rated doors provide manufacturer's standard fire-protection-rated glass meeting the performance requirements specified in Section 08 80 00 - Glazing.

- B. Glazing: As specified in Section 08 80 00, factory installed.
- C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Astragals for Double Doors: Specified in Section 08 71 00.
 - 1. Fire-Rated Doors: Steel, shape as required to accomplish fire rating.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- G. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- H. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes and tolerances are acceptable.
- B. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 08 71 00.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

- F. Comply with glazing installation requirements of Section 08 80 00.
- G. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 11 13

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush configuration; non-rated.
- B. Factory finishing.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- C. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- F. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- G. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- H. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- C. Samples: Submit two samples of door construction, 12 by 12 inches in size cut from top corner of door.

- D. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- E. Documentation indicating that composite wood products and fabrication adhesives contain no urea formaldehyde.
- F. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
 - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
 - 2. Include installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Graham Wood Doors: www.grahamdoors.com.
 - 2. Ipik Door Company; www.ipikdoors.com.
 - 3. Masonite Architectural: www.architectural.masonite.com/#sle.
 - 4. VT Industries, Inc: www.vtindustries.com/#sle.
 - 5. Oshkosh Architectural Door Company; www.oshkoshdoor.com.

2.02 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies made without binders containing urea formaldehyde and faces as indicated above.
 - 1. Particleboard Density: 28-32 pcf.

Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Same species as face veneer.
 - 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
 - 3. Hardwood Veneer Crossbanding: Composition board is not acceptable.
- B. Facing Adhesive: Type I - waterproof, containing no urea formaldehyde.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
 - 3. Provide 5-inch top rail blocking in doors indicated to have closers.
 - 4. Provide 5-inch bottom rail blocking in exterior doors and doors indicated to have kick, mop or armor plates.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- E. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 5 Varnish Conversion.
 - b. Stain: As selected by Architect, where scheduled.
 - c. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.
- C. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 11 13.
- B. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes and tolerances are acceptable.

- B. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.05 SCHEDULE - SEE DRAWINGS

END OF SECTION 08 14 16

SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall-mounted access units.
- B. Ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies◇: Openings in partitions and ceilings.
- B. Section 09 91 23 - Interior Painting: Field paint finish.
- C. Division 22 and Division 23: Mechanical components requiring access.
- D. Division 26: Electrical components requiring access.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; Current Edition.
- B. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. General: The following access panel types are for use as required whether or not indicated on the Drawings, unless indicated elsewhere in Division 22, 23 or 26.
- B. Wall-Mounted Units:
 - 1. Panel Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
 - 2. Size: 12 by 12 inches or as required for access to equipment.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.

C. Wall-Mounted Units in Wet Areas:

1. Material: Stainless steel, No. 4 brushed finish.
2. Size: 12 by 12 inches or as required for access to equipment.
3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.

D. Fire-Rated Wall-Mounted Units:

1. Wall Fire-Rating: As indicated on drawings.
2. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
3. Size: 12 by 12 inches or as required for access to equipment.
4. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.

E. Ceiling-Mounted Units:

1. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
2. Size - Gypsum Board Ceilings: 12 by 12 inches or as required for access to equipment.
3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:

1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
2. ACUDOR Products Inc: www.acudor.com/#sle.
3. Babcock-Davis: www.babcockdavis.com/#sle.
4. Cendrex, Inc: www.cendrex.com/#sle.
5. Milcor, Inc: www.milcorinc.com/#sle.
6. Nystrom, Inc: www.nystrom.com/#sle.

- B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
 - a. Stainless steel where indicated.
 2. Style: Exposed frame with door surface flush with frame surface.
 3. Door Style: Single thickness with rolled or turned in edges.
 - a. Double skinned door panels where indicated.
 4. Frames: 16-gauge, 0.0598-inch minimum thickness.
 5. Single Steel Sheet Door Panels: 16-gauge, 0.0625-inch minimum thickness.
 6. Double-Skinned Hollow Steel Sheet Door Panels: 16-gauge, 0.059-inch minimum thickness, on both sides and along each edge.
 7. Insulation: Non-combustible mineral wool or glass fiber.
 8. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
 9. Steel Finish: Primed.
 - a. Stainless Steel Finish: No.4 brushed finish.
 10. Door/Panel Size: As indicated on the drawings or as required for access to equipment.
 11. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Continuous piano hinge.
 - c. Latch/Lock: Tamperproof tool-operated cam latch.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 31 00

SECTION 08 33 13
COILING COUNTER DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated coiling counter doors and operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 08 71 00 - Door Hardware: Cylinder cores and keys.
- C. Section 09 21 16 - Gypsum Board Assemblies: Rough openings.
- D. Section 09 91 23 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ITS (DIR) - Directory of Listed Products; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish.
- C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- D. Samples: Two slats, 4 inches long, illustrating shape, color, and finish texture.

- E. Manufacturer's Installation Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Specimen warranty.
- I. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for counterbalance shaft assembly. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coiling Counter Doors:
 - 1. Alpine Overhead Doors, Inc; Counter Shutter - Rolling Shutters: www.alpinedoors.com/#sle.
 - 2. C.H.I. Overhead Doors; Model 6522 (steel): www.chiohd.com/#sle.
 - 3. Raynor Garage Doors; DuraShutter, Model ____: www.raynor.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COILING COUNTER DOORS

- A. Coiling Counter Metal Doors, Non-Fire-Rated: Galvanized steel slat curtain.
 - 1. Mounting: Between jambs, within prepared opening.
 - 2. Nominal Slat Size: 1-1/4 inches wide.
 - 3. Slat Profile: Flat.

4. Finish, Galvanized Steel: Factory powder coated.
5. Color: As selected by Architect from manufacturer's full range.
6. Guides: Formed track; same material and finish unless otherwise indicated.
7. Hood Enclosure: Manufacturer's standard; factory powder coated to match door.
8. Manual hand crank lift operation.
9. Locking Devices: Slide bolt on inside.

2.03 COMPONENTS

- A. Metal Curtain Construction: Interlocking, single-thickness slats.
 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
 3. Steel Slats: ASTM A653/A653M galvanized steel sheet, with minimum G90/Z275 coating; minimum thickness 16 gauge, 0.06 inch.
- B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
- C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
- D. Lock Hardware:
 1. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.
- E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that adjacent construction is suitable for door installation.
- B. Verify that electrical services have been installed and are accessible.
- C. Verify that door opening is plumb, header is level, and dimensions are correct.
- D. Notify Architect of any unacceptable conditions or varying dimensions.

- E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION 08 33 13

SECTION 08 38 00
TRAFFIC DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Double-acting self-closing swinging traffic doors.
- B. Door accessories.
- C. Door frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Wall-mounted door stops.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's technical information for each type of door specified, including details about materials, components, profiles, gaskets, and finishes; include:
 - 1. Preparation and installation instructions and methods.
 - 2. Storage and handling requirements and recommendations.
 - 3. Operation and maintenance data.
- C. Shop Drawings: Show installation details of doors and frames, including elevations and attachment.
- D. Selection Samples: For each finish requiring color selection, submit color samples indicating full line of available colors and finishes.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 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. Installer Qualifications: Company specializing in performing type of work specified in this section with not less than three years of documented experience and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product in manufacturer's original unopened packages with label legible and intact.
- B. Store doors at project site on edge or in upright position, under cover and elevated above grade, following manufacturer's instructions.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty for molded polyethylene doors against damage due to worker-ridden vehicle traffic; state limitations in executed warranty.

PART 2 PRODUCTS

2.01 RIGID AND SEMI-RIGID TRAFFIC DOORS

- A. Thermoplastic Double-Acting Traffic Doors Type ____: Hollow core ABS with urethane foam fill.
 - 1. Thickness: 1-1/2 inches.
 - 2. Faces: 1/8 inch minimum thickness; textured or pebble finish.
 - 3. Construction: Manufacturer's standard construction with faces bonded to thermoplastic or aluminum subframe or molded in one piece, reinforced for durability and rigidity, with all edges, cut-outs, and hardware preparations factory fabricated; provide view window cut-outs with joints sealed independently of glazing or trim.
 - 4. Hardware Preparations: Factory reinforce, machine, and prepare for all hardware including field installed items; provide solid blocking for each hardware item; make field cutting, drilling or tapping unnecessary.
 - 5. Bumpers: Provide spring bumpers on both sides of doors.
 - 6. Impact Plates: Provide base plates on both sides of doors.
 - 7. Color: As selected by Architect from manufacturer's standard selection.
 - 8. Manufacturers:
 - a. Chase Doors; ____: www.chasedoors.com/#sle.
 - b. Eliason Corporation; P-11: www.eliasoncorp.com/#sle.
 - c. Rubbair Door, Inc; ____: www.rubbair.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- B. View Windows: Factory installed glazing in molded or extruded _____ thermoplastic or rubber gasket; centered in door width; use single glazing unless otherwise indicated.

1. Square-Shaped Window Size: 12 inches by 16 inches.
2. Single Glazing: Acrylic glazing sheet, 1/4 inch thick, clear.

2.02 ACCESSORIES

- A. Frames: Provide doors pre-hung in frames by door manufacturer; hollow metal for drywall partition welded frame.
- B. Additional Door Hardware: Specified in Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that jambs and frames are square and plumb.
- B. Verify that opening is ready to receive work and opening dimensions and clearances are as indicated on drawings.
- C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
- D. Commencement of work by installer is acceptance of opening conditions.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

- A. Install doors with clearances, anchors, hardware, and accessories according to the manufacturer's instructions and as specified.
- B. Install doors plumb, level, and properly aligned.

3.04 ADJUSTING

- A. Clean and lubricate operating parts.
- B. Adjust doors to open and close smoothly and freely without binding and for proper fit of seals.

3.05 CLEANING

- A. Clean surfaces using methods as recommended by manufacturer.

END OF SECTION 08 38 00

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill trim of metal.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Door hardware.
- F. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Steel attachment members.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section including assigned functions.
- D. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- F. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- L. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
- M. 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).
- N. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.
- O. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2020.

1.04 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.

1.05 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- C. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

- E. Samples: Submit two samples 4 x 6 inches in size illustrating finished aluminum surface.
- F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- H. Designer's qualification statement.
- I. Manufacturer's qualification statement.
- J. Installer's qualification statement.

1.06 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 three years of experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of experience.

1.07 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.

1.08 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.

1.09 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer North America: www.kawneer.com.
- B. Other Acceptable - Aluminum-Framed Storefronts Manufacturers:
 - 1. C.R. Laurence Co., Inc; U.S. Aluminum: www.crl-arch.com.
 - 2. EFCO Corporation: www.efcocorp.com.
 - 3. YKK AP America, Inc.: www.ykkap.com.

2.02 BASIS OF DESIGN -- FRAMING FOR EXTERIOR, INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken, Wind-Borne-Debris Resistance Tested:
 - 1. Basis of Design: Kawneer North America; IR601T Thermal Framing System: www.kawneer.com.
 - 2. Vertical Mullion Dimensions: 2 inches wide by 6 inches deep.

2.03 BASIS OF DESIGN -- SWINGING DOORS

- A. Insulating, Wind-Borne-Debris Resistance Tested - Exterior:
 - 1. Basis of Design: Kawneer North America; 500T Insulpour Thermal Entrance.
 - 2. Thickness: 2-1/4 inches.

2.04 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Finish: Superior performing organic coatings.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 2. Finish Color: As selected by Architect from manufacturer's standard line.
 - 3. 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.

4. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
5. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements for Exterior Storefront:

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - 1) Design wind pressures are indicated on the drawings.
 - b. Member Deflection: Limit member deflection to 1/180 in any direction, with full recovery of glazing materials.
2. Wind-Borne-Debris Resistance: Provide identical full-size glazed assembly without auxiliary protection, meeting all requirements of tested by independent agency in accordance with ASTM E1996 for Wind Zone 4, Basic Protection,. Products that have been tested in accordance with ASTM E 1886 and information in ASTM E 1996 for Wind Zone 3, Basic Protection, are also acceptable.
3. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 12 lbf/sq ft. minimum.
4. Air Leakage: Maximum of 0.06 cu ft/min/sq ft of wall area and maximum of 1.00 cu ft/min/sq ft for pair of doors, when tested in accordance with ASTM E283 at 6.24 pounds per square foot pressure differential across assembly.
5. Condensation Resistance Factor of Framing: 59, minimum, measured in accordance with AAMA 1503.
6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
7. System Internal Drainage: Drain to the exterior by means of a weep drainage network that includes continuous and wept sill flashing any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

9. 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.
10. Overall U-value Including Glazing: 0.39 Btu/(hr sq ft deg F), maximum.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
 3. Cross-Section: As indicated on drawings.
 4. Cross-Section: ____ by ____ inch nominal dimension.
 5. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 - a. ____ by ____ inch nominal dimension.
 6. Sill Flashing: Extruded aluminum pan with end dams.
- B. Glazing: See Section 08 80 00.
 1. For Exterior Framing: Type IG-1.
 2. For Interior Framing and Doors: Type MG-1.
- C. Infill Panels: Insulated, aluminum and sealed.
 1. Total Nominal Thickness: 1 inch.
 2. Finish: Same as storefront.
- D. Swing Doors: Glazed aluminum.
 1. Bottom Rail: 10 inches wide, nominal, complying with ADA requirements.
 2. Glazing Stops: Square.
 3. Finish: Same as storefront.

2.06 MATERIALS

- A. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent.

- B. Extruded Aluminum: ASTM B221.
- C. Sheet Aluminum: ASTM B209.
 - 1. Painted Finish: 3003-H14 Aluminum Alloy, 0.080 inch thick.
- D. Structural Steel Sections: ASTM A36/A36M; shop primed after fabrication.
- E. Fasteners: Stainless steel.
- F. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- G. Concealed Flashings: Sheet aluminum, 26 gauge, 0.017 inch minimum thickness.
- H. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- I. Sealant for Setting Thresholds: Non-curing butyl type.
- J. Perimeter Sealant: Type Exterior specified in Section 07 92 00 - Joint Sealants.
- K. Glazing Gaskets and Sealants: Type to suit application to achieve weather, moisture, air infiltration, wind load and wind-borne debris resistance requirements.
- L. Glazing Accessories: See Section 08 80 00.

2.07 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: As selected by Architect from manufacturer's standard range including metallic and exotic.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 HARDWARE

- A. Other Door Hardware: See Section 08 71 00.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.
- C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all exterior doors.
- D. Threshold: Extruded aluminum, one piece per door opening, ribbed surface, compatible with exit device; provide on all exterior doors.
- E. Interior Hinges: Butt type; top, intermediate, and bottom.

1. Provide on doors as indicated.
- F. Exterior Hinges: Continuous gear type meeting performance requirements.
 1. Provide on all exterior doors.
- G. Push/Pull Set: Custom configuration push/pull handles.
 1. Provide on doors as indicated.
- H. Exterior Exit Devices: Match those utilized in laboratory testing; function as indicated.
 1. Provide on doors as indicated.
- I. Interior Exit Devices: Function as indicated.
 1. Provide on doors indicated as egress doors.
- J. Door Closers: Concealed overhead.
 1. Provide on doors as indicated.
- K. Handle Latch: Function as indicated.
 1. Provide on doors as indicated.
- L. Locks: Dead latch with thumbturn inside ; keyed cylinder outside.
 1. Provide on doors as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install 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. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.

- F. Install sill flashings with integral end dams in continuous bed of mastic.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Install hardware using templates provided.
 - 1. See Section 08 71 00 for hardware installation requirements.
- K. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- L. Install perimeter sealant in accordance with Section 07 92 00 - Joint Sealants.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as directed by Architect.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
- B. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as directed by Architect.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.

- a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
- 4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.
 - a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft.
- C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.06 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, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 43 13

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
- 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 "Flush Wood Doors".
 - 3. Division 08 Section "Stile and Rail Wood Doors".
 - 4. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 5. Division 08 Section "All-Glass Entrances".
- 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. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. 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. Control Systems - System and Components Requirements.
 5. UL 305 – Panic Hardware.
 6. ANSI/UL 437- Key Locks.

1.03 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.
 - 3. Submission of Special Locking Systems (L.A.C. 55:V:3211) to the Louisiana Office of State Fire Marshal: Where electrified, delayed-egress, access controlled, specialized care locking arrangements, and other electrically controlled hardware systems exist in the project, submit Special Locking Submittal electronically to the Office of State Fire Marshal for review and approval after first obtaining submittal approval from the Architect. Pay associated fees.
- 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. 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.

- F. 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.

1.04 QUALITY ASSURANCE

- A. Hardware Supplier and Hardware Installer must obtain a license with the Louisiana Office of State Fire Marshall in accordance to RS 40:1646 and RS 40:1574.
- 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.
- 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. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- H. Keying Conference: Conduct conference to comply with requirements in Division 01. 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.
- I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 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
- J. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.05 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".

1.06 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 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.

1.07 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. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
 - 2. Five years for exit hardware.
 - 3. Twenty five years for manual overhead door closer bodies.
 - 4. Five years for motorized electric latch retraction exit devices.
 - 5. Two years for electromechanical door hardware.

1.08 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.02 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified 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: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
- 5. Manufacturers:
 - a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

2.03 POWER TRANSFER DEVICES

- A. 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 Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.
 - 2. Manufacturers:
 - a. Hager Companies (HA) - Quick Connect.
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – QC-C Series.
 - c. Stanley Hardware (ST) – WH Series.

2.04 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
 - 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. Door Controls International (DC).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls 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. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 5. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.05 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.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.

4. 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.
 5. Keyway: Match Facility Restricted Keyway.
- D. Interchangeable Cores: Provide small format interchangeable cores as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- E. 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.
- F. 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).
- G. Construction Keying: Provide temporary keyed construction cores.
- H. 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.

2.06 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
 2. Locks are to be non-handed and fully field reversible.
 3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.
 4. Manufacturers:
 - a. Sargent Manufacturing (SA) – 10 Line.

2.07 AUXILIARY LOCKS

- A. Cylindrical Deadlocks: ANSI/BHMA A156.36, Grade 1, cylindrical type deadlocks to fit standard ANSI 161 preparation and 1 3/8" to 1 3/4" thickness doors. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.
 - 1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 480 Series.

2.08 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.

2.09 ELECTRIC STRIKES

- A. Standard Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.
 - 1. Manufacturers:

a. HES (HS) - 1006 Series.

B. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. 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.
2. 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.
3. 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.
4. 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.
5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
6. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.
7. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.
8. 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.
- 9. 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.
- 10. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
- 11. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
- 12. Rail Sizing: Provide exit device rails factory sized for proper door width application.
- 13. 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 panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
 - 1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.

2.11 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 (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade 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, closing sweep, and latch speed control valves. Provide non-handed units standard.
 1. Manufacturers:
 - a. Sargent Manufacturing (SA) – 1431 Series.

2.12 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 certified 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. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.13 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 certified 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. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.14 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 NPFA 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. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.15 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.

2.16 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

3.01 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.

3.02 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.03 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. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

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. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. 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.

3.04 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures" and "Cash Allowances". 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.
 2. Submit documentation of incomplete items in the following formats:
 - a. PDF electronic file.
 - b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

3.05 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.

3.06 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.

3.07 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.08 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.

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Storefront framing.
 - 2. Glazed entrances.

1.02 RELATED REQUIREMENTS

- A. Division 08 Section "Decorative Glass Glazing" for back-painted glass.
- B. Division 08 Section "Mirrors."

1.03 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.04 PERFORMANCE REQUIREMENTS

- A. General: 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.
- B. Delegated Design: Design glass, including comprehensive engineering analysis by a qualified professional engineer, using the following design criteria:
 - 1. Design Wind Pressures: As indicated on Drawings; Sheet S1.00.
 - 2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.05 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of the following products; 12 inches square.
 1. Coated glass.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. 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.

1.06 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for laminated insulating glass.
- B. Warranties: Sample of special warranties.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated.

Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
- G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which 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.

- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which 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.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glass Products: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
1. Marvin
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
1. Obtain tinted glass from single source from single manufacturer.
 2. Obtain reflective-coated glass from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. General: 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.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design exterior glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
- D. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes testing requirements in ASTM E 1996 for Wind Zone 3, Hurricane Susceptible Region, when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than

glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.
 2. Small-Missile Test: For glazing located more than 30 feet above grade.
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For laminated-glass lites, properties are based on products of construction indicated.
 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

2.03 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.04 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.
1. Product: PPG; Starphire.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
- E. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
 1. Product: [Insert manufacturer's name; product name or designation].

2.05 LAMINATED GLASS

- A. Laminated Glass, Interior: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph in "Glass Products, General" Article, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Construction: Laminate glass with the following to comply with interlayer manufacturer's written recommendations:
 - a. Polyvinyl butyral interlayer.
 - b. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
 - c. Ionomeric polymer interlayer.
 - d. Cast-in-place and cured-transparent-resin interlayer.

- e. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.
- 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
- 3. Interlayer Color: Clear unless otherwise indicated.
- C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.06 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 - 2. Spacer: Manufacturer's standard spacer material and construction.
 - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Laminated-Glass Types" Article.

2.07 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications and performance requirements indicated and for conditions existing at time of installation.
 - 3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
 - 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Products:

- a. Dow Corning Corporation; 790.
 - b. Pecora Corporation; 890NST.
 - c. Tremco Incorporated; Spectrem 1.
2. Applications: <Describe types of glazing applications where this sealant is required>.

2.08 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
1. EPDM complying with ASTM C 864.
 2. Silicone complying with ASTM C 1115.
 3. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.09 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.11 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit 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. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.03 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.07 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove non-permanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.08 GLAZING SCHEDULE

- A. Glass Type MG-1: Clear float glass.
 - 1. Thickness: 6.0 mm.
- B. Glass Type MG-2: Clear fully tempered float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Provide safety glazing labeling.

- C. Glass Type LG-1: Low-e-coated, laminated vision glass with two plies of clear float glass strengthened as required to meet performance requirements.
 - 1. Thickness of Each Glass Ply: 6.0 mm.
 - 2. Interlayer Thickness: As required to meet performance requirements.
 - 3. Low-E Coating: On second surface.
 - 4. Visible Light Transmittance: 68 percent minimum.
 - 5. Summer Daytime U-Factor: 0.87 maximum.
 - 6. Solar Heat Gain Coefficient: 0.43 maximum.
 - 7. Provide safety glazing labeling.
- D. Glass Type IG-1: Low-e-coated, clear insulating laminated glass.
 - 1. Overall Unit Thickness: Nominally 1-5/16 inch
 - 2. Thickness of Outdoor Lite: 6.0 mm.
 - 3. Outdoor Lite: Fully tempered.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.
 - a. Thickness of Each Glass Ply: 6.0 mm.
 - b. Interlayer Thickness: 0.090 inch, minimum, or as required to meet performance requirements.
 - 6. Low-E Coating: On second surface.
 - 7. Visible Light Transmittance: 60 percent minimum.
 - 8. Summer Daytime U-Factor: 0.26 maximum.
 - 9. Solar Heat Gain Coefficient: 0.28 maximum.
 - 10. Provide safety glazing labeling.

END OF SECTION 08 80 00

SECTION 08 91 00
LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 05 41 00 - Cold-Formed Metal Framing: Supplementary framing for wall opening.
- B. Section 07 25 00 - Weather Barriers: Sealing frames to water-resistive barrier installed on adjacent construction.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim.
- D. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012 (Reapproved 2015).
- C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021.
- D. AMCA 540 - Test Method for Louvers Impacted by Wind Borne Debris.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. FEMA P-361 - Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms; 2021.
- G. ICC 500 - ICC/NSSA Standard for the Design and Construction of Storm Shelters; 2020.

1.04 SUBMITTALS

- A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.

- C. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior surfaces.
- D. Test Reports: Independent agency reports showing compliance with specified performance criteria.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of experience.

1.06 WARRANTY

- A. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include 20 year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Impact-Resistant Louvers:
 - 1. Airolite Company, LLC: www.airolite.com/#sle.
 - 2. American Warming and Ventilating: www.awv.com/#sle.
 - 3. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 4. Greenheck Fan Corporation: www.greenheck.com

2.02 LOUVERS

- A. Louvers, General: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
 - 1. Wind Load Resistance: Design to resist positive and negative wind load pressures as indicated on the Drawings without damage or permanent deformation.
 - 2. High-Velocity Wind Load Resistance: Design to comply with applicable requirements of ICC 500 and FEMA P-361, including resistance to horizontal debris impact.
 - 3. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.

4. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
 5. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
- B. Stationary Louvers: Horizontal blade, formed galvanized steel sheet construction, with intermediate mullions matching frame.
1. Wind-Borne Debris-Resistance: Identical full-size assembly without auxiliary protection tested by independent agency in accordance with AMCA 540 for Wind Zone 3, Basic Protection, for Large Missile impact and pressure cycling at design wind pressure.
 2. Free Area: 45 percent, minimum.
 3. Blades: V-shaped, sight-proof.
 4. Frame: Manufacturer's standard depth, channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
 5. Steel Thickness, Galvanized: Frame 16 gauge, 0.0598 inch minimum base metal; blades 16 gauge, 0.0598 inch minimum base metal.
 6. Steel Finish: Superior performing organic coating, finished after fabrication.
 7. Color: As selected from manufacturer's standard colors.
 8. Basis of Design Product: Greenheck Fan Corporation; Model EHH-601D: www.greenheck.com.

2.03 MATERIALS

- A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

2.04 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Primer: Zinc chromate, alkyd type.
- C. Color: As selected from manufacturer's standard colors.

2.05 ACCESSORIES

- A. Blank-Off Panels: Galvanized steel face and back sheets, polyisocyanurate foam core, 1-1/2 inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.

- B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
- C. Bird Screen: Interwoven wire mesh of steel, 14 gauge, 0.0641 inch diameter wire, 1/2 inch open weave, square design.
- D. Insect Screen: 18 x 16 size aluminum mesh.
- E. Fasteners and Anchors: Galvanized steel.
- F. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- G. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.
- H. Sealant: Exterior type, as specified in Section 07 92 00 - Joint Sealants.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Set sill members and sill flashing in continuous bead of sealant.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Secure louver frames in openings with concealed fasteners.
- F. Install perimeter sealant and backing rod in accordance with Section 07 92 00.
- G. Coordinate with installation of mechanical ductwork.

3.03 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION 08 91 00

SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Thin-set ceramic tile.
 - 3. Sealer.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- E. Patching compound.
- F. Remedial floor coatings.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.
- B. Section 03 30 00 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.
- C. Section 03 35 11 - Sealed Concrete.

1.03 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.

- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2021.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2022.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Covering; 2013.

1.04 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used;
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Manufacturer's installation instructions.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Submit report to Architect.
 - 7. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.

1.05 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

- B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any

recommendation from flooring manufacturer, provide a product with the following characteristics:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Thickness: 1/8 inch, maximum.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
1. Preliminary cleaning.
 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 5. Specified remediation, if required.
 6. Patching, smoothing, and leveling, as required.
 7. Other preparation specified.
 8. Adhesive bond and compatibility test.
 9. Protection.
- B. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
 - 3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 09 05 61

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation and acoustic sealant.
- E. Gypsum wallboard including backing board for wet areas.
- F. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- D. Section 06 16 43 - GYPSUM SHEATHING.
- E. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- F. Section 07 92 00 - Joint Sealants: Sealing gaps in construction other than gypsum board or plaster work.
- G. Section 08 31 00 - Access Doors and Panels: Access panels.
- H. Section 12 36 00 - Countertops: Countertop support brackets with concealed vertical leg.

1.03 DEFINITIONS

- A. Wet Areas: Wet areas include the following:
 - 1. Walls supporting sinks, toilets and urinals.

1.04 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- I. 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; 2022.
- J. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- K. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- M. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.
- N. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
- O. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- P. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- Q. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- R. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- S. UL (FRD) - Fire Resistance Directory; Current Edition.

1.05 SUBMITTALS

- A. Product Data: Provide data on metal framing, accessories, joint finishing system, and each type of board material specified.

1.06 QUALITY ASSURANCE

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 PRODUCTS

2.01 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 55 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-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
- B. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich Building Systems: www.clarkdietrich.com.
 - 2. Jaimes Industries: www.jaimesind.com/#sle.
 - 3. Marino: www.marinoware.com.
 - 4. SCAFCO Corporation: www.scafco.com/#sle.
 - 5. Telling Industries, LLC; www.buildstrong.com.
- C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Minimum Base Metal Thickness: 0.0247 inch (0.626 mm) 25 ga. in all locations unless otherwise required to be 0.0396 inch (1.005 mm) 20 ga. where the following conditions exist:
 - a. Where the floor to floor height (limiting height) exceeds the allowable deflection of 0.0247 inch (0.626 mm) 25 ga. studs.
 - b. At stair shafts, elevator hoistways, and other vertical shafts.
 - c. At partitions to receive stone cladding, ceramic tile, cementitious backer board, abuse-resistant gypsum board, plywood, wood panels, projection screens, marker or chalkboards, veneer plaster, gypsum plaster or interior portland cement plaster.
 - d. At partitions to receive cabinets, countertops, shelving, other wall supported millwork, casework, furniture items, wall-hung plumbing fixtures without chair carriers, countertop support brackets and equipment either furnished and installed by the Contractor, furnished and installed by the Owner or furnished by the Owner and installed by the Contractor.
 - e. At framing for door frames; refer to Part 3, Installing Framed Assemblies.
 - f. At cantilevered furring and miscellaneous framing supports.
 - g. At fire-rated and STC-rated partitions where required by the UL-listing or other testing agency.
 - h. Note: All of the above mentioned materials may not be used on this project.
 - 2. Studs: C-shaped with knurled or embossed faces.

3. Runners: U shaped, sized to match studs.
4. Ceiling Channels: C-shaped.
5. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
6. Furring Members: Zee-shaped sections, minimum depth of 1 inch.
- D. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- E. Partition Head To Structure Connections at Non-Rated Walls: Provide track fastened to structure with legs of sufficient length to accommodate minimum 1 inch deflection, for friction fit of studs cut short .
- F. Partition Head to Structure Connections at Rated Walls: Provide mechanical anchorage devices that accommodate minimum 1 inch deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 1. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
 2. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
 3. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
- G. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
 1. Products:
 - a. ClarkDietrich; BlazeFrame Firestop Deflection Track: www.clarkdietrich.com/#sle.
 - b. Fire Track Corp.; Shadowline.
 - c. Marino; Deflection Drift Angle.
 - d. Telling Industries; Deflection and Firestopping Track.
- H. Non-structural Framing Accessories:
 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

- I. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
- J. Countertop Support Brackets with concealed vertical leg: Coordinate with specification Section 12 36 00 - Countertops, if applicable.

2.03 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.

2.04 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:

- 1. American Gypsum Company: www.americangypsum.com/#sle.
- 2. CertainTeed Corporation: www.certainteed.com.
- 3. Georgia-Pacific Gypsum: www.gpgypsum.com.
- 4. National Gypsum Company: www.nationalgypsum.com/#sle.
- 5. USG Corporation: www.usg.com.

B. Gypsum Wallboard: Mold-resistant paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; tapered long edges, ends square cut and meeting the following:

- 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
- 2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
- 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold resistant board is required at all locations.
- 4. Type: Fire-resistance rated Type X, UL or WH listed.
- 5. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Impact Resistant Wallboard:

- 1. Application: from finished floor to 8' min. in the Dining Hall, Lobby, and Servery.

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. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
8. Type: Fire-resistance-rated Type X, UL or WH listed.
9. Thickness: 5/8 inch.
10. Edges: Tapered.
11. Glass Mat Faced Products:
 - a. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant: www.gpgypsum.com/#sle.
 - b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel: www.goldbondbuilding.com/#sle.
 - c. USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough VHI Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.

D. Backing Board For Wet Areas:

1. Application: Partitions in wet areas including walls supporting sinks, toilets and urinals.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch.
 - b. Products:
 - 1) CertainTeed Corp.; GlasRoc Tile Backer.
 - 2) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
 - 3) Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.

4) USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough.

- 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.
- 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: 5/8 inch.
 - 3. Edges: Tapered.
- G. Exterior Sheathing Board: As specified in Section 06 16 43 - GYPSUM SHEATHING.
- H. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
 - 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

2.05 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed mineral fiber, friction fit type, unfaced. Thickness: 3 inch minimum but thicker where required to meet a higher STC rating.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
 - 3. Products:
 - a. Same manufacturer as framing materials.

- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 2. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners at assemblies containing glass mat faced board.
 - 3. Joint Compound: Drying type, vinyl-based, ready-mixed.
- E. Screws for Fastening of Gypsum Panel Products to Wood Members and Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
- F. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- G. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
 - 1. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with AISI S220 and manufacturer's instructions.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

1. Level ceiling system to a tolerance of 1/1200.
 2. Laterally brace entire suspension system.
 3. Install bracing as required at exterior locations to resist wind uplift.
- D. 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 - Non-Rated: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
 4. Partitions Terminating at Structure - Rated: 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.
- E. Countertop Support Brackets: Install brackets in accordance with manufacturer's written instructions.
1. Installation of brackets indicates acceptance of stud gage and installation.
 2. Coordinate with Section 12 36 00 - Countertops.
- F. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- G. Standard Wall Furring: Install at concrete 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: Vertical.
- H. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- I. Blocking: Install mechanically fastened steel sheet blocking or wood blocking for support of:
1. Framed openings.
 2. Wall-mounted cabinets.
 3. Plumbing fixtures.
 4. Toilet partitions.

5. Toilet accessories.
6. Wall-mounted door hardware.
7. Grab bars.
8. Coordinate with Section 06 10 00 - Rough Carpentry.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation in Walls: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions unless otherwise indicated.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 1. Place one bead continuously on substrate before installation of perimeter framing members.
 2. Place continuous bead at perimeter of each layer of gypsum board.
 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
 1. Install gypsum board 1/2 inch above surface of slab to prevent wicking of moisture unless otherwise indicated.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
 2. Exception: Install gypsum board perpendicular to framing at stairwells and walls in excess of 12 feet in height.
- C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

- F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
- G. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board with sealant.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and in accordance with ASTM C 840 in specific locations approved by Architect for visual effect.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

- A. Glass Mat Faced and Water-Resistant Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish, unless otherwise indicated.
 - 2. Level 5: Walls and ceilings to receive wall coverings, unless otherwise indicated.
 - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. 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 are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - 3. Taping, filling, and sanding are not required at base layer of double-layer applications.

3.08 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.09 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09 21 16

SECTION 09 30 00
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Stone thresholds.
- D. Ceramic trim.
- E. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 08 31 00 - Access Doors and Panels: Access panels.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- D. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.
- E. Division 22: Plumbing Fixtures.

1.03 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 2017.
- C. ANSI 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 Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2021).
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 2021.

- F. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017.
- G. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- H. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- I. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- J. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
- K. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- L. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2019.
- M. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- N. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018.
- O. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- B. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Tile: [CHOICE TEXT] of each size, color, and surface finish combination, but not less than 10 square feet of each type.

1.06 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 0.60.
 - 2. Step Treads: Minimum 0.80.
 - 3. Ramp Surfaces: Minimum 0.80.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE - REFER TO DRAWINGS FOR PRODUCTS

- A. Ceramic Mosaic Tile, Type TL-1: ANSI A137.1, standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: 2 by 2 inch, nominal.
 - 3. Shape: Square.
 - 4. Edges: Cushioned.
 - 5. Surface Finish: Unglazed.
 - 6. Color(s): As indicated on drawings.
- B. Quarry Tile, Type TL-3: ANSI A137.1, standard grade.
 - 1. Moisture Absorption: Over 3.0 but not more than 5.0 percent as tested in accordance with ASTM C373.

2. Size: 6 by 6 inch, nominal.
3. Thickness: 1/2 inch, nominal.
4. Edges: Square.
5. Surface Finish: Non-slip.
6. Color(s): As indicated on drawings.
7. Trim Units: Matching cove base shapes in sizes coordinated with field tile.

C. Porcelain Tile, Type _____: ANSI A137.1 standard grade.

1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: 6 by 6 inch, nominal.
3. Thickness: 3/8 inch.
4. Edges: Interlocking shape.
5. Surface Finish: Unglazed.
6. Color(s): As indicated on drawings.
7. Trim Units: Matching bullnose, cove base, and cove shapes in sizes coordinated with field tile.

D. Porcelain Floor Tile:

1. Size and Shape: 12 inch by 24 inch, rectangular.
2. Color(s): As indicated on Drawings.

2.02 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose and cove base ceramic shapes in sizes coordinated with field tile.

1. Applications:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base.
2. Manufacturers: Same as for tile.

B. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.

1. Applications:
 - a. Open edges of wall tile, where indicated.
 - b. Wall corners, outside.
 - c. Borders and other trim as indicated on drawings.
2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle.
 - b. Genesis APS International: www.genesis-aps.com/#sle.
- C. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
 1. Thickness: 1/2 inch.
 2. Material: Marble, honed finish.
 3. Color and Pattern: As indicated on drawings.
 4. Applications:
 - a. At doorways where tile terminates.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 2. Bostik Inc: www.bostik-us.com/#sle.
 3. Custom Building Products: www.custombuildingproducts.com/#sle.
 4. LATICRETE International, Inc: www.laticrete.com/#sle.
- C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.
 2. Products:
 - a. ARDEX Engineered Cements; S 28: www.ardexamericas.com/#sle.

- b. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer:
www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; MULTIMAX LITE: www.laticrete.com/#sle.
- D. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
- 1. Applications: Quarry tile

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Applications: All tile locations
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX WA: www.ardexamericas.com/#sle.
 - b. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout:
www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
 - d. Sika Corp; SikaTile 825 Epoxy: www.sika.com/#sle.

2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
 - 2. Specified in Section 07 92 00 - Joint Sealants.

2.06 ACCESSORY MATERIALS

- A. Backer Board: Specified in Section 09 21 16 - Gypsum Board Assemblies.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 09 05 61.
 - 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 - 3. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Existing Concrete: Mechanically prepare steel troweled concrete to comply with surface finish requirements in ANSI A108.01; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- D. Apply mortar bed at shower floor that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drain. Integrate with shower curb.
- E. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- F. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- G. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 TILE INSTALLATION - GENERAL

- A. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- B. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- C. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

- D. Form internal angles square and external angles bullnosed.
- E. Install non-ceramic trim in accordance with manufacturer's instructions.
- F. Install thresholds where indicated.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control joints free of adhesive or grout. Apply sealant to joints.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- L. Apply mildew-resistant silicone sealant, meeting ASTM C920, to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - TYPICAL TILE FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Use underlayment product under tile in locations indicated.
 - 2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
 - 3. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.

3.05 INSTALLATION - FLOORS - FLOATING

- A. Install in accordance with manufacturer's instructions.
- A. Grout with standard grout as specified above.

3.06 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
- B. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

3.07 CLEANING

- A. Clean tile and grout surfaces.

3.08 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 30 00

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Division 21 - Fire Suppression: Sprinkler heads in ceiling system.
- C. Division 23 - HVAC: Air diffusion devices in ceiling.
- D. Division 26 - Electrical: Light fixtures in ceiling system.
- E. Division 28 - Electronic Safety and Security: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
- C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- F. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.
- G. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two full size samples illustrating material and finish of acoustical units.
- D. Samples: Submit 2 samples each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Suspension Systems: One unopened box of suspension system material.
 - 2. Extra Acoustical Units: Not less than three unopened cartons of acoustical ceiling materials.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.08 WARRANTY

- A. Ceiling Panels: Warrant ceiling panels to be free from sagging, warping, shrinking, buckling or delaminating as a result of manufacturing defects for a period of one (1) year from the date of Substantial Completion.
- B. Suspension System: Warrant suspension system to be free from defects in material or factory workmanship for a period of ten (10) years from the date of Substantial Completion. Warranty shall

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:

1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
2. CertainTeed Corporation: www.certainteed.com/#sle.
3. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com/#sle.
Rockfon, LLC: www.rockfon.com/#sle.
4. USG Corporation: www.usg.com/ceilings/#sle.

B. Wood Veneer Acoustic Panels:

1. CertainTeed Corporation; ____: www.certainteed.com/ceilings-and-walls/#sle.

C. Suspension Systems:

1. Same as for acoustical units.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

1. VOC Content: As specified in Section 01 61 16.

B. Acoustical Panels, Type ACP-1: Mineral fiber with membrane-faced overlay, with the following characteristics:

1. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
2. Size: 24 by 24 inches.
3. Thickness: 3/4 inch.
4. Panel Edge: Tegalur.
5. Suspension System Type 1: Exposed grid.
6. Products:
 - a. As indicated on the drawings.

- C. Acoustical Panels, Type ACP-2: Mineral fiber with scrubbable finish, with the following characteristics:
1. Application(s): Food service areas.
 2. Classification: ASTM E1264 Type IX.
 - a. Form: 1, nodular.
 - b. Pattern: "G" - smooth.
 3. Thickness: 3/4 inch.
 4. Panel Edge: Square.
 5. Suspension System Type 2: Exposed grid.
 6. Products:
 - a. As indicated on the drawings.
- D. Wood Veneer Acoustic Panels Type ____: Medium density fiberboard (MDF) core with wood veneer face and non-woven acoustical fabric backer.
1. Panel Size: ____ by ____ inches.
 2. Panel Thickness: 5/8 inch.
 3. Noise Reduction Coefficient (NRC): 0.85 when tested in accordance with ASTM C423 for Type F5 mounting, per ASTM E795.
 4. Provide MDF with no added urea formaldehyde (NAUF).
 5. Surface Veneer Species: White Oak.
 - a. Factory Finish: Clear sealer.
 6. Panel Weight: 1.88 psf.
 7. Perforated Panel: Pattern microperf .
 8. Edge Profile: Square.
 9. Installation:
 - a. Direct mount ceiling installation.
 - b. Suspension System: Concealed grid Type ____.
 10. Products:
 - a. CertainTeed Corporation; Rondolo: www.certainteed.com/ceilings-and-walls/#sle.

2.03 SUSPENSION SYSTEM(S)

A. Manufacturers:

1. Same as for acoustical units.

B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

1. Materials:

- a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

C. Exposed Suspension System, Type 2: Hot-dipped galvanized steel grid with aluminum cap.

1. Application(s): Food service areas.
2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
3. Profile: Tee; 15/16 inch face width.
4. Finish: Baked enamel.
5. Color: White.

D. Exposed Suspension System, Type 1: Hot-dipped galvanized steel grid and cap.

1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
2. Profile: Tee; 9/16 inch face width.
3. Finish: Baked enamel.
4. Color: White.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Perimeter Moldings: Same metal and finish as grid.

1. Size: As required for installation conditions.

2. Shadow Molding: Shaped to create a perimeter reveal.
- E. Edge Trim for "Cloud" Suspension Systems: Provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
 1. Trim Height: 4 inch.
 2. Finish: same wood veneer as wood panel ceiling.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, and ASTM E580/E580M and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected ceiling plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 1. Use longest practical lengths.
 2. Miter corners.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- F. Where round obstructions occur, provide preformed closures to match perimeter molding.
- G. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 51 00

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
- B. ASTM F2034 - Standard Specification for Sheet Linoleum Floor Covering; 2018.
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.04 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Shop Drawings: Indicate seaming plans and floor patterns.
- C. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Flooring Material: 90 square feet of each type and color.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

1.07 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Linoleum Sheet Flooring - Type RF-1: Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness.
 1. Manufacturers:
 - a. Forbo Flooring, Inc: www.forboflooringna.com/#sle.
 2. Minimum Requirements: Comply with ASTM F2034, Type corresponding to type specified.
 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
 4. Backing: Jute fabric.
 5. Thickness: 0.100 inch, minimum, excluding backing.

6. Seams: Chemically bonded using seam sealer.
7. Pattern: Solid color.
8. Color: As indicated on drawings.

2.02 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
 1. VOC Content Limits: As specified in Section 01 61 16.
- C. Moldings, Transition and Edge Strips: Rubber.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 09 05 61.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
 3. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:

1. Spread only enough adhesive to permit installation of materials before initial set.
 2. Fit joints and butt seams tightly.
 3. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
1. Resilient Strips: Attach to substrate using adhesive.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Cut sheet at seams in accordance with manufacturer's instructions.
- C. Chemically bond seams using seam sealer where indicated.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 65 00

SECTION 09 72 00
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Linoleum/cork wallcovering .

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 21 16 - Gypsum Board Assemblies: Substrate.
- C. Section 09 91 23 - Interior Painting: Preparation and priming of substrate surfaces.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.04 SUBMITTALS

- A. Product Data: Provide data on wall covering and adhesive.
- B. Shop Drawings: Indicate wall elevations with seaming layout.
- C. Samples: Submit two samples of wall covering, 12 by 12 inch in size illustrating color, finish, and texture.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering; store where directed.
 - 3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers:

- 1. Koroseal:

2.02 WALL COVERINGS

- A. General Requirements:

- 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

- B. Wall Covering: WC-1, complying with the following:

- 1. Construction: Synthetic and natural fibers containing minimum 20% post-consumer recycled content.
 - 2. Roll Width: 48 inches.
 - 3. Color: as selected from manufacturer's full range.
 - 4. Surface Texture: Smooth.
 - 5. Products:
 - a. Koroseal; TacWall

- C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

- D. Termination Trim: J-trim for TacWall, stain clear aluminum color.

- E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.02 PREPARATION

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- C. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
- C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- D. Horizontal seams are not acceptable.
- E. Do not seam within 2 inches of internal corners or within 6 inches of external corners.
- F. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.
- G. Do not install wall covering more than 1/4 inch below top of resilient base.
- H. Cover spaces above and below windows, above doors, in pattern sequence from roll.
- I. Apply wall covering to electrical wall plates prior to replacing.
- J. Where wall covering tucks into reveals, or metal wallboard or plaster stops, apply with contact adhesive within 6 inches of wall covering termination. Ensure full contact bond.

- K. Install termination trim.
- L. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet.
Wipe clean with dry cloth.

3.04 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

- A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION 09 72 00

SECTION 09 91 13
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Finish exposed surfaces of steel lintels and ledge angles.
 - 2. Galvanized stairs, handrails, and guardrails.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished; galvanized metal components are not considered factory-finished..
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other types of tiles.
 - 9. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 10. Glass.
 - 11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 50 00 - Metal Fabrications: Shop-primed items.

C. Section 09 91 23 - Interior Painting.

1.03 REFERENCE STANDARDS

- A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- E. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
- C. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on aluminum sheet, ____ x ____ inch in size.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.

2. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience.

1.06 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, two feet long by two feet wide, illustrating paint color, texture, and finish for each selection.
- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Locate where directed by Architect.
- E. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:

1. Base Manufacturer: _____.
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. 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.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: As indicated in Color Schedule.

1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including fiber cement siding, primed metal, and fiber cement panels.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
 - 3. Top Coat Sheen:
 - a. Satin: MPI gloss level 4; use this sheen at all locations.
 - 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint WE-OP-3A - Wood, Opaque, Alkyd, 3 Coat:
 - 1. One coat of alkyd primer sealer.
 - 2. Semi-gloss: Two coats of alkyd enamel.
- C. Paint GE-OP-2X -Exterior Plaster, Opaque, Elastomeric, 2 Coat:
 - 1. One coat of <> primer sealer recommended by paint manufacturer.
 - 2. Flat: One coat of Exterior Pigmented Elastomeric, Water Based; MPI # 113.
- D. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
 - 1. One coat of alkyd primer.
 - 2. Semi-gloss: Two coats of alkyd enamel.
- E. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
 - 1. One coat galvanize primer.
 - 2. Semi-gloss: Two coats of alkyd enamel.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 - 1. Alkali Resistant Water Based Primer; MPI #3.
 - 2. Interior/Exterior Latex Block Filler; MPI #4.
 - 3. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
 - 4. Alkyd Primer for Galvanized Metal.

5. Alkyd/Oil Primer for Exterior Wood; MPI #5.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Exterior Plaster and Stucco: 12 percent.
 2. Fiber Cement Siding: 12 percent.
 3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

- G. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- H. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- I. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and hand tools. Protect from corrosion until coated.
- J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 91 13

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Materials for backpriming woodwork.
- D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Elevator pit ladders.
 - 3. Finish carpentry items unless shop finished.
 - 4. Prime surfaces to receive wall coverings.
 - 5. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
- E. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.

9. Glass.
10. Acoustical materials, unless specifically indicated.
11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- C. Section 05 51 00 - Metal Stairs: Shop-primed items.
- D. Section 09 21 16 - Gypsum Board Assemblies.
- E. Section 09 72 00 - Wall Coverings.
- F. Section 09 91 13 - Exterior Painting.

1.03 REFERENCE STANDARDS

- A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.04 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 2. MPI product number (e.g., MPI #47).
 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 1. Where sheen is specified, submit samples in only that sheen.

2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 2. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1.06 MOCK-UP

- A. Provide panel, two feet long by two feet wide, illustrating paint color, texture, and finish for each selected color.
- B. Provide door and frame assembly illustrating paint color, texture, and finish.
- C. Locate where directed by Architect.
- D. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:

1. Base Manufacturer: _____.
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. 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.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: As indicated on drawings.

1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete masonry units, and wood.
 1. Two top coats and one coat primer.
 2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
 3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - b. Eggshell: MPI gloss level 3; use this sheen at all locations unless indicated otherwise.
 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
 1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
 2. Two top coats and one coat primer.
 3. Top Coat(s): Interior Alkyd; MPI #47, 48, 81, or 96.
 4. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
 5. Primer: As recommended by top coat manufacturer for specific substrate.
- C. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including gypsum board not scheduled to receive applied finishes in bathrooms, toilet rooms, and food service areas.
 1. Two top coats and one coat primer.
 2. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.
 3. Top Coat Sheen:
 - a. Eggshell: MPI gloss level 3; use this sheen at all locations.
- D. Paint MI-OP-3A - Ferrous Metals, Primed and Unprimed, Alkyd, 3 Coat:

1. One coat of alkyd primer.
 2. Semi-gloss: Two coats of alkyd enamel.
- E. Paint MGI-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
 2. Semi-gloss: Two coats of alkyd enamel.
- F. Paint GI-P-1A - Wall Surfaces To Receive Wall Covering, Alkyd Primer, 1 Coat:
1. One coat of alkyd primer sealer; MPI #136.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Alkali Resistant Water Based Primer; MPI #3.
 2. Interior/Exterior Latex Block Filler; MPI #4.
 3. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
 4. Alkyd Primer for Galvanized Metal.
 5. Stain Blocking Primer; MPI #136.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:

1. Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Masonry:
 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
- G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- I. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 91 23

SECTION 09 93 00
STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of stains and transparent finishes.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 20 00 - Finish Carpentry.
- C. Section 06 41 00 - Architectural Wood Casework.
- D. Section 06 42 00 - Wood Paneling.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.05 SUBMITTALS

- A. Product Data: Provide complete list of 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. MPI product number (e.g. MPI #33).
 - 3. Manufacturer's installation instructions.

- B. Samples: Submit two samples, illustrating selected colors and sheens for each system. Submit on actual wood substrate to be finished, 12 x 12 inch in size.
- C. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Stain and Transparent Finish Materials: 1 gallon of each color and type; from the same product run, store where directed.
 - 2. Label each container with color and type in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide finishes from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
3. Substitution of a different system using MPI-approved products by the same manufacturer will be considered.

B. Transparent Finishes:

1. Pittsburgh Paints; _____: www.ppgpaints.com/#sle.
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Stains:

1. Pittsburgh Paints; _____: www.ppgpaints.com/#sle.
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. 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.
4. Supply each finish material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.

2.03 EXTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood:

1. Two coat(s) varnish over one coat(s) stain.
2. Stain: Exterior Semi-Transparent Stain for Wood, Water Based; MPI #156.

3. Top Coat(s): Exterior Clear Water-Based Varnish with UV Inhibitor; _____.
4. Top Coat Sheen:
 - a. Satin: MPI gloss level 4; use this sheen at all locations.

2.04 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood - Vertical Surfaces:

1. Two coat(s) varnish over one coat(s) stain.
2. Stain: Semi-Transparent Stain for Wood, Water Based; MPI #186.
3. Top Coat(s): Clear Water-Based Varnish; MPI #128, 129, or 130.
4. Top Coat Sheen:
 - a. Satin: MPI gloss level 4; use this sheen at all locations.

B. Finish on Wood - Floors.

1. Two coat(s) varnish over one coat(s) stain.
2. Stain: Semi-Transparent Stain for Wood; MPI #90.
3. Top Coat(s): Polyurethane Varnish, Oil Modified; MPI #56 or 57.
4. Top Coat Sheen:
 - a. Satin: MPI gloss level 4; use this sheen at all locations.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D. Sand wood surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- G. Reinstall items removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finishes until completion of project.

- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 93 00

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. High performance coatings.
- B. Surface preparation.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 91 13 - Exterior Painting.

1.03 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- E. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

- A. Product Data: Provide 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 (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47) if applicable.
 - 3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
- B. Samples: Submit two samples 8 by 8 inch in size illustrating colors for verification.
- C. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include cleaning procedures and repair and patching techniques.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Coating Materials: 1 gallon of each type and color.
 - 2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years experience.

1.06 MOCK-UPS

- A. Provide mock-up , 4 feet long by 4 feet wide, illustrating coating, color, and surface sheen , for each specified coating.
- B. Locate where directed.
- C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- D. Restrict traffic from area where coating is being applied or is curing.

1.09 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for bond to substrate and degradation of chemical resistance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide high performance coating products from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for submittals.
 - 2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
 - 3. Substitution of a different high performance coating system using MPI-approved products by the same manufacturer will be considered.
- B. High-Performance Coatings:
 - 1. Basis of Design: Tnemec Company, Inc: www.tnemec.com/#sle.
 - 2. Dow: www.dow.com/#sle.
 - 3. PPG Paints: www.ppgpaints.com/#sle.

2.02 HIGH-PERFORMANCE COATINGS

- A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
 - 2. NFPA 101, Class A rated.

2.03 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
 - 1. Volatile Organic Compound (VOC) Content: See Section 01 61 16.
- B. High-Build Epoxy Coating:

1. Number of Coats: Two.
2. Top Coat(s): Epoxy, High-Build.
 - a. Sheen: Low gloss.
 - b. Basis of Design Product:
 - 1) Tnemec Company, Inc; Series 66 Epoxoline: www.tnemec.com/#sle.
3. Primer: As specified under "PRIMERS" below.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.
 1. Zinc Rich, Urethane.
 - a. Basis of Design Product:
 - 1) Tnemec Company, Inc; Series 90G-1K97: www.tnemec.com/#sle.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not begin application of coatings until substrates have been properly prepared.
- C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.02 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- C. Remove finish hardware, fixture covers, and accessories and store.

D. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning", and protect from corrosion until coated.

3.03 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified or recommended and recommendations in MPI - Architectural Painting and Specification Manual.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

- A. Protect finished work from damage.

END OF SECTION 09 96 00

SECTION 10 14 00
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cash allowance for signs.
- B. Room and door signs.
- C. Interior directional and informational signs.
- D. Building identification signs.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Substrate.
- B. Division 26 - Electrical: Exit signs required by code.

1.03 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 21 00 - Allowances, for cash allowances affecting this section.
- B. Allowance amount covers purchase and delivery but not installation.

1.04 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.05 SUBMITTALS

- A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, physical sign location keyed to floor plan, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.

3. Submit for approval by Owner through Architect prior to fabrication.
4. Include floor plan key
- C. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- E. Verification Samples: Submit samples showing colors specified.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum [three] years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.08 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs:
 1. ASI Signage Innovations: www.asisignage.com.
 2. Best Sign Systems, Inc: www.bestsigns.com/#sle.
 3. Cosco Industries: www.coscoarchitecturalsigns.com/#sle.
 4. FASTSIGNS: www.fastsigns.com/#sle.
 5. Mohawk Sign Systems, Inc; ____: www.mohawksign.com/#sle.
- B. Dimensional Letter Signs:

1. ASI Signage Innovations: www.asisignage.com.
2. Cosco Industries: www.coscoarchitecturalsigns.com/#sle.
3. FASTSIGNS; _____: www.fastsigns.com/#sle.

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room Signs: Provide a sign for every room, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 1. Sign Type: Flat signs with applied character panel media as specified.
 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 3. Character Height: 1 inch.
 4. Sign Height: 6 inches, unless otherwise indicated.
 5. Office Doors: Identify with [CHOICE TEXT].
 6. Conference and Meeting Rooms: Identify with [CHOICE TEXT].
 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
 1. Sign Type: Same as room and door signs.
 2. Assembly Spaces: Provide signage indicating maximum occupant load near the main exit from the room or as indicated on the drawings.
 - a. Size, configuration, and wording shall be as required by regulatory authorities.
- D. Building Identification Signs:
 1. Use individual metal letters.
 2. Mount on outside wall in location indicated on drawings.

2.03 SIGN TYPES

- A. Flat Room Signs: Signage media without frame.

1. Edges: Square.
2. Corners: Square.
3. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
4. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Color and Font: Unless otherwise indicated:

1. Character Font: Helvetica, Arial, or other sans serif font.
2. Character Case: Upper case only.
3. Background Color: As scheduled.
4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

A. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.

1. Total Thickness: 1/8 inch.
2. Letter Thickness: 1/8 inch.
3. Letter Edges: Square.

2.05 DIMENSIONAL LETTERS

A. Metal Letters:

1. Metal: Aluminum casting.
2. Metal Thickness: 1/8 inch minimum.
3. Letter Height: As indicated on drawings.
4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper and lower case (title case).
5. Finish: Brushed, satin.
6. Mounting: Concealed screws.

2.06 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.
- C. Blank-off panels: For signage installed over glass, provide and install a blank off panel on the opposite side of the glass from the signage; size, color, fastening method and material to match signage unless otherwise noted.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 00

SECTION 10 21 13.16
PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic laminate toilet compartments.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
- B. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- C. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- B. PS 1 - Structural Plywood; 2009 (Revised 2019).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, ____ x ____ inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Laminate Toilet Compartments:
 - 1. ASI Accurate Partitions; ____: www.asi-accuratepartitions.com/#sle.
 - 2. ASI Global Partitions; ____: www.asi-globalpartitions.com/#sle.

3. General Partitions Mfg. Corp; ____: www.generalpartitions.com/#sle.
4. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Plywood for Core: Softwood, PS 1 Grade B-B, Exterior grade.
- B. Plastic Laminate: NEMA LD 3, HGS.
- C. Adhesive: Contact type.

2.03 COMPONENTS

- A. Toilet Compartments: Plastic laminate finished, floor-mounted unbraced.
- B. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of plywood core, with beveled corners and edges; edges of cut-outs sealed.
 1. Plastic Laminate Color: Single color as selected, satin finish.
- C. Door and Panel Dimensions:
 1. Thickness: 1 inch.
 2. Door Width: 24 inch.
 3. Door Width for Handicapped Use: 36 inch , out-swinging.

2.04 ACCESSORIES

- A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inches high, concealing floor fastenings.
 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow chrome plated steel tube, 1 x 1-5/8 inch size, with anti-grip strips and cast socket wall brackets.
- C. Wall and Pilaster Brackets: Polished stainless steel.
- D. Wall Brackets: Continuous type, polished stainless steel.
- E. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
 1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.
- F. Steel Plate Reinforcement: Carbon steel, prepared for fasteners, 1/8 inch thick.
- G. Hardware: Polished stainless steel:

1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
2. Thumb turn door latch with exterior emergency access feature.
3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
4. Coat hook with rubber bumper; one per compartment, mounted on door.
5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return outswinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 10 21 13.16

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Under-lavatory pipe supply covers.
- C. Diaper changing stations.
- D. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 08 83 00 - Mirrors: Other mirrors.
- C. Section 09 21 16 - Gypsum Board Assemblies: Roughed-in wall openings.
- D. Section 10 21 13.16 - Plastic-Laminate-Clad Toilet Compartments.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
- G. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- I. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).

- J. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.05 SUBMITTALS

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 2. Bobrick Washorrm Equipment, Inc.: www.bobrick.com.
 - 3. Bradley Corporation: www.bradleycorp.com/#sle.
- B. Under-Lavatory Pipe Supply Covers:
 - 1. IPS Corporation; Trubro Lav Guard 2: www.ipsplumbingproducts.com.
 - 2. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
- C. Diaper Changing Stations:
 - 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 2. Bobrick Washorrm Equipment, Inc.: www.bobrick.com.
 - 3. Bradley Corporation: www.bradleycorp.com/#sle.
 - 4. Koala Kare Products: www.koalabear.com/#sle.
- D. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Keys: Provide three keys for each accessory to Owner.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- H. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted, for coreless type rolls.
 - 1. Products:
 - a. American Specialties, Inc; ____: www.americanspecialties.com/#sle.
 - a. Kimberly-Clark Corporation; Kimberly-Clark Professional Scott Pro Toilet Paper Dispenser: www.kcprofessional.com/#sle.
- B. Combination Towel Dispenser/Waste Receptacle: Recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
 - 1. Waste receptacle liner: Reusable, heavy-duty vinyl.
 - 2. Towel dispenser capacity: 400 C-fold.

3. Waste receptacle capacity: 4 gallons.
- C. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
- D. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 2. Size: As indicated on drawings.
 3. Frame: 0.05 inch channel shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
- E. Grab Bars: Stainless steel, smooth surface.
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.
- F. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

2.05 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
 3. Construction: 1/8 inch flexible PVC.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - b. Comply with ASTM C1822, type indicated.

- c. Comply with ASME A112.18.9.
- d. Comply with ICC A117.1.
- e. Microbial and Fungal Resistance: Comply with ASTM G21.
- 4. Color: As selected by Architect.
- 5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

2.06 DIAPER CHANGING STATIONS

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 - 1. Material: Polyethylene.
 - 2. Mounting: Surface.
 - 3. Color: As selected.
 - 4. Minimum Rated Load: 250 pounds.

2.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
 - 2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
 - 3. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify exact location of accessories for installation.
- B. Verify that field measurements are as indicated on product data.
- C. See Section 06 10 00 and 09 21 16 for installation of blocking and reinforcing plates in walls and ceilings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 28 00

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 09 21 16 - Gypsum Board Assemblies: Roughed-in wall openings.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide; current edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. Product Data: Provide extinguisher operational features.
- B. Shop Drawings: Indicate cabinet physical dimensions and rough-in measurements for recessed cabinets.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.06 WARRANTY

- A. 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 valves.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:

1. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
2. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
3. Nystrom, Inc: www.nystrom.com/#sle.
4. Potter-Roemer: www.potterroemer.com/#sle.

B. Fire Extinguisher Cabinets, Fire Extinguishers and Accessories:

1. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
2. Nystrom, Inc: www.nystrom.com/#sle.
3. Potter-Roemer: www.potterroemer.com/#sle.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.

1. Class: A:B:C type.
2. Size: 5 pound.
3. Finish: Baked polyester powder coat color as selected.
4. Temperature range: Minus 40 degrees F to 120 degrees F.

C. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.

1. Class: K type.

2. Size: 1.6 gallons.
3. Finish: Polished stainless steel.
4. Temperature range: Minus 20 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 1. Formed primed steel sheet; 0.036 inch thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- D. Cabinet Configuration: Semi-recessed type unless otherwise indicated.
 1. Size to accommodate accessories.
 2. Trim for Semi-Recessed Cabinets where Indicated: Returned to wall surface, with maximum 4 inch projection, 2-1/2 inch wide face.
 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
 4. Bracket: Hook type.
- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with lock and breakable window access. Hinge doors for 180 degree opening with continuous piano hinge.
- F. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- G. Door Lettering: Vertical decal lettering; black.
- H. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- I. Fabrication: Weld, fill, and grind components smooth.
- J. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
- K. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.

- B. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 40 inches from finished floor to operable part of fire extinguisher unless noted otherwise.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets, unless noted otherwise.

END OF SECTION 10 44 00

SECTION 10 51 13
METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal lockers.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
- D. Samples: Submit two samples 3 by 6 inches in size showing color and finish of metal locker material.
- E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Lockers:

2.02 LOCKER APPLICATIONS

- A. TA-50 Gear Lockers: Metal lockers, free-standing.
 - 1. Configuration: Single tier.
 - 2. Fittings:
 - a. Upper shelf.
 - b. Hooks: Four single prong.
 - 3. Ventilation: Perforated side panels, doors, and back panels.
 - 4. Latching: Three-point, Cremone latching, with padlockable turn handle.

5. Locking: Padlock hasps, for padlocks provided by Owner.

2.03 METAL LOCKERS

- A. Locker Case Construction:
- B. Latches and Door Handles: Manufacturer's standard.
- C. Locks: Locker manufacturer's standard type indicated in Applications article above.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Install fittings if not factory installed.
- E. Replace components that do not operate smoothly.

END OF SECTION 10 51 13

SECTION 11 40 00
FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 STANDARDS

- A. Equipment and installation thereof shall meet all requirements of applicable portions of latest editions of Standards listed below.
 - 1. American Society for Testing Materials (ASTM)
 - 2. National Electrical Code (NEC)
 - 3. American Gas Association (AGA)
 - 4. Louisiana State Board of Health
 - 5. National Sanitation Foundation (NSF)
 - 6. Factory Mutual (FM)
 - 7. Underwriters Laboratory (UL)
 - 8. Occupational Safety and Health Administration (OSHA)
 - 9. National Fire Protection Association (NFPA)
 - 10. International Building Code (IBC)
 - 11. American Disabilities Act (ADA)

1.03 DESCRIPTION OF WORK

- A. Work in This Section Includes the Following:
 - 1. Furnishing, delivery, uncrating, setting in place at locations indicated on drawings. Installation to include mounting, leveling, adjusting, and cleaning all equipment specified herein.
 - 2. Apply permanent foot/caster placement markings to building floor at all cooking equipment requiring coverage of fire suppression system in accordance with NFPA-96 codes.
 - 3. All components required for a complete assembly to serve intended function when connected to mechanical and electrical services.
 - 4. Coordination of all work required for a complete installation with other trades and subcontractors.
 - 5. Field verification of plumbing and electrical rough-ins by Food Service Equipment Contractor to ensure requirements and locations are correct. Said verification shall include all electrical characteristics (amperage, voltage, and phase) for all Existing, Contractor-Furnished, and Owner-Furnished Equipment. Field verification shall commence prior to release of equipment order and pouring of concrete slab by General Contractor.
 - 6. Sink faucets, strainers, vacuum breakers, duo drains, lever handle drains and tailpieces specified under heading entitled Fabrication Standards.

7. Furnishing and mounting of all electrical starting switches, controls, light fixtures, and receptacles included in Itemized Equipment Specifications or as required for operation of equipment specified herein.
8. Furnish and install all refrigeration lines and components for remote condensers in accordance with manufacturers' requirements.
9. Cutting of all holes in equipment tops, shelves and bodies required for piping (gas, water and drains) and wiring.
10. Threaded hanger rods with brackets and turn buckles required to support Exhaust Hoods.

B. Related Work Specified Elsewhere:

1. Water/gas piping, line shut-off valves and final connections to equipment.
2. Drain piping, floor drains, floor sinks, "P" traps, grease traps and final connections to equipment.
3. Electrical wiring, overload protection devices, line-disconnect switches, and final connections to equipment.
4. Install cord/plug assemblies provided by Food Service Equipment Contractor.
5. Roof curb for remote walk-in cooler/freezer condensing unit package located on building roof (verify location).
6. Exhaust/supply fans (including magnetic starters/ductwork/roof curb) and welding exhaust ducts to exhaust duct collars of exhaust hoods to meet applicable fire codes.
7. Air balancing of exhaust/supply fans of Exhaust Hoods to meet project requirements.
8. Structural framing where required at hanger rod locations to support Exhaust Hoods and/or Walk-In Coolers and/or Freezers.
9. Wall blocking for support of wall-mounted equipment (where applicable).

1.04 DRAWINGS AND SPECIFICATIONS

- A. Specifications and drawings shall be considered as a part of the Contract to be executed. Intent of said Drawings and Specifications is for all components required for a complete installation of food service equipment specified.
- B. Should any error, omission or conflict occur in Drawings and Specifications, Contractor shall not avail himself of such error, omission or conflict but shall have same explained and adjusted prior to signing the Contract.
- C. All addenda shall be considered as a part of original Contract Documents.

1.05 QUALITY AND WORKMANSHIP

- A. All equipment shall be constructed in strict compliance with standards of National Sanitation Foundation and shall bear the NSF label. All equipment shall meet all standards set by state and local regulations.
- B. All electrical equipment shall be approved by Underwriter's Laboratories and shall bear its seal of approval.
- C. All electrical components of equipment shall meet requirements of National Electric Code.
- D. All material shall be new (latest model at time of delivery) and of first quality. All equipment shall be installed in an undamaged condition. Where brands, materials, apparatus, or equipment are specifically designated, no substitution shall be made without prior approval in writing.

- E. Provide all Work in best manner in conformity with best standard practices. Employ qualified, efficient, and skillful workers for installation in a first-class manner.
- F. It is required that custom fabricated equipment be fabricated by a Food Service Equipment Fabricator who has plant, personnel and engineering facilities to design, detail and manufacture high quality equipment.

1.06 FOOD SERVICE EQUIPMENT CONTRACTOR QUALIFICATIONS

- A. Contractor shall possess experience and ability to perform the necessary services for a complete and workmanlike installation of food service equipment.
- B. Contractor experience shall include a minimum of five (5) years' experience as a successful Food Service Equipment Contractor and shall have successfully completed installation of at least five (5) comparable projects of similar size and nature.
- C. Contractor's in-house capabilities shall include preparation of dimensioned mechanical/electrical rough-in Drawings, experienced personnel to coordinate with other trades the proper equipment installation, warranty services, and proper demonstration of equipment on operation, service, and maintenance.

1.07 SUBMITTALS

- A. Submittals shall include product data (manufacturer's specification sheets) of standard-manufactured equipment, shop drawings of custom-fabricated equipment and equipment modified to meet project requirements, and dimensioned mechanical and electrical rough-in drawings of equipment utility requirements. Partial submittals will be given no consideration.
 - 1. Product data shall be submitted in electronic pdf format unless stated otherwise in Contract Documents and shall be in numerical order (by equipment item numbers). Each manufacturer's specification sheet shall be preceded with a type-written sheet that includes equipment description, quantity, brand/model number, accessories, and modifications to meet project requirements.
 - 2. Shop drawings are not to be based upon reproduction of Contract Document drawings. Shop drawings shall be submitted in electronic pdf format unless stated otherwise in Contract Documents. Shop drawings for custom-fabricated equipment shall be drawn at a minimum scale of $\frac{3}{4}$ " to the foot with cross-sections drawn at 1-1/2" to the foot. Sheet sizes shall be same size as sheet sizes of Contract Document drawings, not to exceed 30" x 42".
 - 3. Equipment floor plan, mechanical, and electrical rough-in drawings are not to be based upon reproduction of Contract Document drawings. Drawings shall be submitted in electronic pdf format. Rough-in drawings shall show utility requirements of equipment specified, existing equipment to be re-used, future equipment (including vendor-furnished equipment), area clean-up floor drains, and electrical convenient outlets shown on Contract Document drawings. Rough-in requirements shall be accurately drawn to scale with dimensions from centerline of columns or finished walls. Contractor shall be responsible for determining exact locations on building walls and floors and not connection points on equipment. Contractor shall visit project site to verify correct locations of utility stub-outs and floor recesses/block-outs prior to pouring of concrete slab and report discrepancies found to Architect and/or Consultant. Refer to certification requirements of Description of Work of this section.
 - 4. Contractor shall be responsible for taking all field dimensions which affect equipment and installation thereof. At the time of taking field measurements and observation of existing

conditions, Contractor shall report in writing to Architect all work performed by other trades which will prevent him from execution of his work required by Contract Documents and shall obtain Architect's instructions before proceeding with his work.

1.08 PROTECTION OF WORK AND MATERIALS

- A. Contractor shall always cover and protect his Work, material, and equipment to save same from damage. Contractor shall always exercise due care to protect the work of others. Cost of any repair or replacement of damaged Work, material and equipment shall be borne by Contractor.

1.09 BRANDS AND TRADE NAMES

- A. Contractors are cautioned that only food service equipment and related items manufactured in accordance with Specifications will be acceptable. Where brand names and model numbers are specified, it is not intended that competition be limited, but to set standards of performance, design, capacity, durability, and appearance. Bidders desiring to quote and/or supply brands of equipment other than those specified shall submit a written request to Architect with a copy to Consultant seven (7) days prior to bid date in order that such substitutions can be considered for approval and if approved, an addendum issued to all plan holders. It is understood that approval of substitutions does not relieve Contractor from furnishing equipment to meet intent and requirements of Specifications. Approval of substitutions does not relieve Contractor from additional costs of mechanical and electric utilities and other requirements not included in Contract Documents.

1.10 WARRANTIES

- A. Contractor shall provide a one (1) Year Warranty from date of Substantial Completion or occupancy on all Work provided under these Specifications. Warranty shall cover replacement of defective material, transportation, and labor, but does not include costs of replacement parts and labor caused by Owner's carelessness or misuse of equipment. An additional four (4) year warranty (labor included) shall be provided on all refrigeration compressors. Contractor shall provide a reputable and qualified service agency, located within fifty (50) miles of Project site, to provide immediate service for all refrigeration equipment.

PART 2 - PRODUCTS

2.1 CUSTOM FABRICATED EQUIPMENT MANUFACTURERS

- A. Equipment manufacturers shall be Low Temp Industries, Inc.; Atlanta Custom Fabricators; and Stainless & Aluminum Fabrication, or a prior approved equivalent.
- B. All fabricated equipment shall be manufactured by one (1) manufacturer to ensure uniformity in design and finish.

2.2 ELECTRICAL REQUIREMENTS

- A. Refer to Drawings for specific requirements.
- B. Fixtures wired for three-phase shall have loads balanced as equally as possible.

2.3 SWITCHES AND CONTROLS

- A. A suitable control switch or starter of proper type in accordance with Underwriter's Code shall be supplied for each motorized appliance or electrically-heated unit.
- B. Said switches and controls shall be mounted in recessed die-stamped stainless-steel cups or otherwise indented to prevent damage.

2.4 METAL FABRICATION STANDARDS

- A. Materials:
 - 1. All stainless steel shall be type 302 or 304 with 18% chromium, 8% nickel, and a maximum of 0.12% carbon. All sheets shall have a No. 4 finish with colors and finish uniform throughout.
- B. Welding:
 - 1. All welded parts shall be non-porous and free from imperfections, pits, cracks, or discolorations.
 - 2. Stainless steel joints and seams shall be heli-arc welded ground smooth and polished to a No. 4 finish. Welds of galvanized steel shall be ground smooth, sand-blasted and sprayed with molten zinc at 1200 degrees Fahrenheit to a thickness of .004". Tinning of welds is not acceptable. All welds shall be ground smooth and polished to original finish of metal.
- C. Field Joints:
 - 1. Field joints shall be located for practical construction with sizes convenient for shipping and entry into building spaces.
 - 2. All field joints shall be fully (continuous) welded with same type metal, ground smooth and polished to original finish of metal.
- D. Table and Counter Tops:
 - 1. All tops, unless otherwise specified, shall be constructed of 14-gauge stainless steel. Exterior edges not adjacent to walls or other equipment shall be turned down on a 90-degree angle or rolled down 1-3/4" with corners bullnosed. Tops adjacent to walls shall be turned up 6" and back 1" (minimum) on a 90-degree angle to form a backsplash. Tops adjacent to other equipment shall be flanged straight down 1-3/4". Sound deadening material shall be provided between frame members and stainless-steel tops.
 - 2. Edges of dishtable tops not adjacent to walls shall be turned up 3" and rolled down 1-1/2" with corners bullnosed. Dishtable tops adjacent to walls shall be turned up 10", back 2-1/2" on a 45-degree angle and down 2" to form a pipe chase. All horizontal edges and internal corners of dishtable tops shall be coved on a 5/8" minimum radius. Ends of backsplashes shall be closed, welded, ground smooth and polished.
 - 3. Edges of preparation counter tops (with sinks) not adjacent to walls shall be turned up 7/8" on a 45-degree angle and turned down on a 90-degree angle or rolled down 2-5/8" to form a marine roll unless specified otherwise. Preparation counter tops (with sinks and cantilevered overshef uprights) adjacent to walls shall be turned up 10", back 2-1/4" on a 45-degree angle and turned down 1" on 90-degree angle to form a backsplash with pipe chase. All horizontal edges and internal corners of preparation counter tops shall be coved on a 5/8" minimum radius. Ends of backsplashes shall be closed, welded, ground smooth and polished. Backsplashes of counter tops with sinks shall be pierced on 8" centers over sinks.
 - 4. All tops shall be reinforced on the underside with 12-gauge (minimum) stainless steel hat channels running from front to back with center bracing where required to hold tops flat. Channels shall be stud welded and bolted to underside of tops with legs, bodies and drawer

housings secured to channels so that bolts or rivets will not extend through work tops. Holes required for counter equipment shall be neatly die-punched with raised edges.

E. Backsplashes:

1. Backsplashes of table and countertop with 90-degree turnbacks adjacent to walls shall be turned down 1" at 90-degrees and secured to building walls with 4" long 14-gauge stainless steel "zee" clips on 36" centers. Cracks between backsplashes and building walls shall be sealed with clear silicone sealant.
2. Backsplashes of preparation counters and dishtables with 45-degree turnbacks adjacent to walls shall be turned down 1" at 135-degrees and secured to walls with 4" long 14-gauge stainless steel "zee" clips on 36" centers. Cracks between backsplashes and building walls shall be sealed with clear silicone sealant.

F. Open Bases:

1. Open bases shall be constructed of 1-5/8" OD 16-gauge stainless steel tubular uprights and crossbraces fully welded together, ground smooth and polished. Top of cross braces shall be 12" above floor. Refer to Drawings for arrangement of crossbraces. Uprights shall be fitted at floor with adjustable, sanitary stainless steel bullet feet inserted into uprights with inside threads to eliminate any possibility of threading collecting dirt and other matter. Tops of legs shall be fitted into die-stamped fully enclosed stainless steel gussets equivalent to Component Hardware No. A20-0206-C welded to reinforcing channels on underside of stainless-steel tops.
2. Tables 6'-0" long and under shall have four (4) legs, and tables 7'-0" long shall have six (6) legs. Legs shall be spaced not more than 5' 0" apart unless specified otherwise.

G. Cabinet Bodies and Bases:

1. All cabinet bodies and bases shall be enclosed with 18-gauge stainless steel. Exterior vertical corners shall be square.
2. Bodies and bases shall be mounted on 6" high sanitary adjustable counter legs equivalent to component Hardware No. A48-5048.

H. Undershelves and Interior Shelves:

1. All undershelves and interior shelves shall be constructed of 18-gauge stainless steel.
2. Undershelves on open base tables shall be sectional, removable, and rolled down over crossbraces, unless otherwise specified in Itemized Equipment Specifications. Shelves adjacent to walls and other equipment shall turn up 2". Shelves shall be notched around table uprights and crossbraces, so that undershelves are easily removable. All edges of sections adjacent to each other shall be turned down 1" (minimum) for rigidity.
3. All interior shelves of cabinet bodies and bases shall be stationary unless specified otherwise. Sides and rear edges of shelves shall be turned up 1-1/2", down 1-1/2" and in 2" on front. Shelves shall be welded to cabinet bodies and braced on underside. Welding marks or spots shall not be visible on exterior of counter base panels. Where removable interior shelves are specified, edges of shelves shall be turned down 1-1/2" on all sides with sections supported by angle framework. Where plumbing and other appurtenances pass through counter bases, 5" wide open chases, concealed by 6" wide rear vertical pilaster trim, shall be provided to accommodate piping.

I. Elevated Shelves:

1. Elevated shelves shall be constructed of 16-gauge stainless steel and shall be turned down 1-1/2" on front and ends with sanitary semi-rolled edges with bullnosed corners. Rear sides of shelves shall be turned up 1-1/2".
2. Free-standing shelves, unless specified otherwise, shall be mounted on 1" OD stainless steel tubular uprights mounted to counter tops in a sanitary manner (tube inserts when

- accessible from bottom of counter). Wall mounted shelves shall be equipped with stainless steel angle wall brackets anchored to building wall.
3. Shelves, where specified to be mounted on cantilever brackets, shall be mounted on 1-5/8" diameter stainless steel tubular uprights welded to framing of table and counter tops.
- J. Drawers:
1. All drawers shall be 20" x 20" x 5" deep unless specified otherwise. Removable pans shall be formed of one-piece die-stamped 18-gauge stainless steel with top edges flanged out 2". Faces of drawers shall be equivalent to Component Hardware No. J85-2000. Drawers shall operate on ball-bearing roller stainless steel extension slides to allow full opening and shall be fitted with adjustable stops to prevent drawers from being pulled out too far so they will drop down.
 2. Drawers shall be completely enclosed in 18-gauge stainless steel housing attached to undersides of tops on open base tables and shall be attached to framework of cabinet base tables.
- K. Casters:
1. Casters specified for open base tables shall be equivalent to Component Hardware Nos. C23-1250 5" diameter non-braking) and C23-1251 (5" diameter braking).
 2. Casters specified for cabinet base tables shall be equivalent to Component Hardware Nos. C21-3050 and C21-3051.
- L. Sinks:
1. Sinks shall be constructed of 14-gauge stainless steel having back, bottom and front formed of one (1) continuous sheet of metal with ends and partitions welded in place. All vertical and horizontal corners of sink compartments shall be coved with metal on a 5/8" (minimum) radius. No solder filleting will be acceptable. All edges of sink counter tops not adjacent to walls shall be turned up 7/8" on a 45-degree angle and rolled down 2-5/8" to form a marine roll unless specified otherwise. Edges of sink counter tops adjacent to wall shall be turned up 10", back 2-1/4" on a 45-degree angle and down 2" to form a backsplash with pipe chase. All ends of backsplashes shall be closed, ground smooth and polished. Backsplashes shall be pierced on 8" centers over compartment dividers of two, three and four compartment sinks and over center of one compartment sinks unless specified otherwise. Bottom of each sink compartment shall be fitted with Component Hardware No. D50-7200 lever handle drain. Overflow drain assemblies when specified shall be Component Hardware No. D50-7215. Drains shall set into embossed openings in sink bottoms, gasketed and locked in place without use of rivets or bolts. Sinks shall be mounted on 1-5/8" OD 16-gauge stainless steel legs with adjustable stainless-steel feet (same as specified for open base tables). All sink partitions shall be 7/8" thick double wall construction. A model No. B-0231 T & S mixing faucet (12" spout) shall be mounted at center of each single compartment sink and over each partition of each multiple compartment sink. Preparation and utensil wash sinks shall be 12" and 14" deep respectively unless specified otherwise.

2.5 ITEMIZED EQUIPMENT SPECIFICATIONS

- A. Item No. 1 Mixing Faucet w/Hose Threads (One Required):
1. T&S No. B-0665-BSTP or approved equal with No. 002970-45 hose rack (mounted adjacent to mixing faucet)
- B. Item No. 2 Air Door (One Required):

1. Mars No. N248-1UA or approved equal with components/features/accessories as follows:
 - a. No. HSG-TS stainless-steel housing
 - b. Microswitch for automatic on/off operation
- C. Item No. 3 Stainless Steel Floor Mop Sink (One Required):
 1. Advance Tabco No. 9-OP-28 or approved equal with components/features/accessories as follows:
 - a. No. K-240 faucet
 - b. No. K-242 mop hanger
 - c. No. K-244 hose and bracket
- D. Item No. 4 Storage Shelving Units (8) – Owner Furnished, Contractor Installed:
 1. Space and utilities for Metro Super Erecta series or approved equal, each with components/features/accessories as follows:
 - a. Five (5) 21" wide x 48" long epoxy-coated adjustable wire shelves
 - b. 74" high epoxy-coated tubular uprights with foot levelers
- E. Item No. 5 Dunnage Racks (4) – Owner Furnished, Contractor Installed:
 1. Space and utilities for Metro Nos. HP2236PDMB and HP2248PDMB or approved equal, arrangement as indicated on drawings
- F. Item No. 6 Spare Number
- G. Item No. 7 Spare Number
- H. Item No. 8 Walk-In Cooler/Freezer – Owner Furnished, Contractor Installed:
 1. General: Walk-in shall be pre-fabricated modular construction, designed and constructed to allow for fast and easy field assembly, relocation, and modification by addition of modular panels. Walk-in and components thereof shall meet 2009 Energy Code Standards. Walk-in shall be installed and/or commissioned by a certified factory technician.
 2. Project Requirements: Walk-in shall be floor type installed within 7" deep concrete floor recess with thick-set quarry tile wearing floor surface, same level as adjacent floor surface.
 3. Size: Walk-in shall be 17'4" wide x 11'-7" deep x 8'-6" high with arrangement indicated on drawings.
 4. Finishes: Exposed exterior wall and ceiling panels (including exposed floor and ceiling caps) shall be 20-gauge type 304 No. 3 finish stainless steel. Interior wall and ceiling panels shall be 26-gauge galvanized steel with mill-applied white enamel. Interior/exterior door/door panels shall be 20-gauge type 304 No. 3 finish stainless steel with 36" high kick plates. Unexposed wall and ceiling panels shall be 26-gauge galvanized steel. Floor panels shall be 14-gauge galvanized steel (unexposed).
 5. Panel Construction: Panels shall consist of metal pans, formed to precise dimensions, with "foamed-in-place" urethane to permanently bond to inner metal surfaces to form strong rigid units. Standard wall, ceiling, and floor panels shall 11½", 23", 34½", 46", and 69" wide. Standard corner panels shall be 12" x 12" on 90-degree angle. Special fabricated panels shall be provided to meet project requirements. Panels shall be equipped with NSF-approved double-bead interior and exterior vinyl gaskets which are resistant to stains, grease, oil, mildew, and sunlight. Panels shall be equipped with cam-action locking

- mechanisms (hook and arm assemblies) securely mounted in matching panel locations to form air-tight and vapor-proof joints. Locking mechanism parts shall be equipped with urethane plugs and snap-in caps to match interior finish of panels.
6. Insulation: Insulation shall be 4" thick rigid, low ozone depleting HCPC 22 blown Class 1 urethane foam classified according to UL723 (ASTM-E-84) as tested by Underwriter's Laboratories, Inc. Four (4) inch core material shall have a flame spread of 25 or less and a smoke density of 250. Insulation shall have a thermal conductivity (K Factor) of not more than 0.125 BTU/hr/sf per degree Fahrenheit/inch, on overall coefficient of heat transfer (U factor) of not more than .031, and R factor of 32. Pre-fabricated urethane foam panels shall be supplied with a Class 1 fire hazard classification according to UL723 (ASTM-E-84) as tested by Underwriter's Laboratories, Inc. Panels shall have a flame spread rating of 25 or less with a certifying UL label.
 7. Entrance Doors and Door Panels: Refer to drawings for door locations and directions of door swings. Doors shall be 36" wide x 76" high, infitting flush-mounted type with one-piece perimeter PVC accordion-type removable gasket with magnetic core at top and side perimeters at doors. Adjustable wiper gaskets shall be mounted on bottom edge of doors. Door latches shall be high pressure zinc die cast with polished chrome finish with break-away inside safety release handles so that doors can be opened from inside, even if locked, and cylinder locks. Doors shall be equipped with Kason No. 1346 Performer adjustable hinge. Doors shall be equipped with positive-action hydraulic door closers to ensure positive closing of doors. Hinges of 36" wide doors shall be 9-inch modified strap, cam-lift, self-closing design with door lift-off capability, same type and finish as door latches. Rubber door stopper shall be installed on exterior front panel to prevent damage of panel by handle when door is opened to a full 180 degrees. Aluminum diamond treadplates (1/8" thick) shall be mounted on the lower 36" of interior and exterior door surfaces. Door panels shall be equipped with heavy reinforced steel "U" channel frame on entire door perimeter. Anti-sweat heater cables shall be run in breaker strips located behind removable heavy-gauge stainless steel trim for easy access to heater cables. Heater cables shall be run within heavy-gauge "U" channels of 12-gauge stainless steel (minimum) thresholds. Each door panel shall include a pre-wired Kason No. 1806LED000 LED-light fixture with globe and 11.5-watt lamp, 2½" diameter chrome face, and flush-mount dual-reading adjustable dial thermometer on exterior surface to provide temperature readings of minus 40-degrees F to plus 60-degrees F and minus 40-degrees C to 15-degrees C.
 8. Pressure Relief Ports: Walk-in cooler and freezer rooms shall include 2-way heated pressure relief ports (vents) to equalize pressure between interior and exterior pressures caused by sudden temperature changes due to opening doors, loading of products, and/or defrosting of coils. Pressure relief port(s) quantities, sizing, and locations to be determined by walk-in manufacturer.
 9. Ceiling Light Fixtures: Four (4) Kason No. 1810LC4000 48" long LED-light fixtures, each with two lamps (40-watt total) shall be furnished and installed by this Contractor. Junction box assemblies shall include threaded electrical conduit (urethane-filled), junction boxes (installed on top of ceiling panels), and 120-volt wiring to junction box.
 10. Warranty: Walk-in panels shall include a ten (10) year factory warranty (including labor) for defects in materials and workmanship from date of Substantial Completion of project.
 11. Trim Strips and Closure Panels: Trim strips to match finish of exposed exterior walk-in panels shall be furnished and installed in a workmanlike manner to conceal cracks between walk-in and building walls. Closure panels, constructed in accordance with drawings and project requirements, shall be mounted on top of walk-in to match exposed exterior walk-in panels. Where required for access to top of walk-in, removable closure panels are required. Trim strips and closure panels shall be constructed of 18-gauge stainless steel.

12. Temperature Alarm System: Each cooler/freezer room shall include one (1) flush-mounted Modularm No. 75LC multi-monitor with 75LC Communicator, 3-button user interface, digital temperature indicator, built-in audible alarm, built-in dry contacts for remote notification capability of an audio and/or visual alarm condition, built-in transformer, built-in rechargeable battery with recharging circuitry, and built-in data/comm port for system expansion. System shall be provided with Energy Independence and Security Act compliant timing lighting control, Hi-Lo temperature alarm, panic alarm, and door ajar alarm. System shall include magnetic contacts for each door and low voltage IP-1 illuminated push button (to provide light switch and panic alarm functions) inside each cooler/freezer room by the door. The IP-1 will remain lit at all times, even during a power failure. Multiple IP-1's shall be provided by each door in multi-door compartments to integrate with timed lighting function and to replace conventional 3-way light switching. Walk-in manufacturer shall furnish and install rigid conduit and wiring from each flush-mounted monitor mounted in door panels to top of ceiling panels (for field wiring to ceiling lights and specified components, by electrical contractor). Wiring to sensors within cooler/freezer rooms shall be furnished and installed by Food Service Equipment Contractor. System shall include low voltage MD-1 motion detector inside walk-in cooler and freezer rooms above the door for occupancy detection and automatic light control. Temperature sensors shall be located behind the evaporator coils to typify the average ambient temperature of the room. Sensor wiring shall be run above top of walk-in ceiling panels with penetrations (thoroughly sealed with silicone and foam urethane to prevent condensation) at sensor locations. Sensor wiring shall be secured to top of walk-in ceiling panels with continuous duct tape to prevent wiring damage.
 13. Plastic Door Curtains: Exterior cooler/freezer entrance doors shall be equipped with Clear Vu stripless swinging door curtains manufactured by CCI Industries, Inc. (350-A Fischer Ave., Costa Mesa, CA 92626) Phone: (800) 854-5719.
 14. Quality Standards: Walk-in shall be manufactured by Thermo-Kool, American Panel, or approved equal.
 15. Shop drawing required for approval.
- I. Item No. 9 Remote Refrigeration System – Owner Furnished, Contractor Installed:
1. System shall be pre-engineered, factory-assembled, air-cooled, multi-compressor type mounted within a common type 304 stainless steel housing with one-piece louvers and hail guards on building roof. Roof-mounted condensing unit packages shall be mounted on pre-fabricated roof curbs furnished and installed by General Contractor.
 2. System shall include pre-assembled components to include compressors (EPA-approved refrigerant), condensers, ball-bearing fan motors, adjustable head pressure controls, crankcase heaters, suction filters, sight glass driers, liquid line inlet/outlet valves, high-pressure superhose connection, suction/discharge absorbers, and accessories for a complete assembly to meet project requirements.
 3. Condensing unit package shall include factory pre-wired electrical components to include control panel with individual circuit breakers, contactors, Eco-Smart on-demand electric defrost systems for cooler and freezer coils, and main line disconnect for a single electrical connection.
 4. System shall include evaporator coils with factory-assembled thermostats, solenoid valves, expansion valves, on/off disconnect switch, and accessories for a complete and workmanlike installation to meet project requirements.
 5. System shall be Refrigerated Design Technologies (RDT) or approved equal to include one (1) rack no. ZS1-02Z-CT3-EST (31851) with one (1) no. YS11KAE and one (1) YF10KAE

compressors for cooler and freezer rooms respectively; and one (1) no. BEL0095 and one (1) no. BEL0130 evaporator coils for cooler and freezer rooms respectively.

6. Shop drawing required for approval.
 7. Contractor shall furnish and install all necessary valves, controls, oil separators, refrigerant tubing, refrigerant R448A, condensate drain lines, and accessories for a complete and neat workmanlike job in accordance with the best refrigeration practices. Refrigerant piping shall be pressure-tested with nitrogen at 300 psi after condensing units and evaporator coils have been connected prior to charging with refrigerant and testing. All refrigerant lines subject to sweating shall be insulated with AP/Armaflex insulation ($\frac{3}{4}$ " minimum thickness for coolers and 1" thickness for freezers) with all joints sealed with glue as recommended by the manufacturer of the insulation. Duct tape at joints is not acceptable. Thickness of insulation shall be increased to 1-1/2" and 2" for cooler and freezer rooms respectively in poorly-ventilated confined areas to reduce probability of condensation of refrigerant lines. Refrigerant lines shall be rigid, type L copper with all joints soldered to meet the best refrigeration practices. Refrigerant lines shall be anchored to building structure with clamps and galvanized steel saddles as required. Exterior refrigerant lines shall be wrapped with self-fastening 0.016-inch-thick Type 3003-H14 aluminum alloy jacketing utilizing aluminum strapping and seals in accordance with jacketing manufacturer's recommendations for complete weather-tight protection of refrigerant line insulation. Condensate drain lines shall be rigid, type L copper securely fastened to walk-in panels with non-corrosive clamps (straps are not acceptable). Condensate drain lines installed in freezer rooms shall be wrapped with spiral-installed heater tape. Condensate drain lines shall be generously sloped (1/2" per lineal foot minimum) to the bottom of walk-in rooms, extended through walk-in panel, through building walls (where applicable), and trapped outside walk-ins. All refrigeration systems shall be checked out to the Owner's satisfaction. This contractor shall provide an acceptable, local refrigeration service agency which shall provide 24-hour, 7-day warranty service.
- J. Item No. 10 Mobile Shelving Units (9) – Owner Furnished, Contractor Installed:
1. Space and utilities for Metro Super Erecta series or approved equal, each with components/features/accessories as follows:
 - a. Four (4) 21" wide x 48" long epoxy-coated adjustable wire shelves
 - b. 63" high epoxy-coated tubular uprights
 - c. Four (4) 5" diameter urethane swivel casters, two (2) with brakes
- K. Item No. 11 Mobile Pan Racks (3) – Owner Furnished, Contractor Installed:
1. Space and utilities for CresCor No. 207-1820 or approved equal, each with corner bumpers
- L. Item No. 12 Soiled Dishtable w/Cup/Glass Rack and Pre-Rinse Sink – Owner Furnished, Contractor Installed:
1. Space and utilities for 30" wide x 8-0" long x 34" high, arrangement indicated on drawings, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. 20" x 20" x 6" deep pre-rinse sink with removable scrap basket with rack guides
 - b. T & S Brass No. B-0133/B-0109 pre-rinse spray unit with wall bracket
 - c. 21" wide x 5'-6" long stainless-steel cup/glass rack shelf mounted on tubular uprights and cantilever brackets 24" above table top
 - d. Shop drawing required

- M. Item No. 13 Dishwasher (By Vendor)
 - 1. Space and utilities for AutoChlor No. AC44 conveyor-type unit (left to right operation), Low-temp or High-temp to be determined

- N. Item No. 14 Condensate Exhaust Hood – Owner Furnished, Contractor Installed:
 - 1. 72” long x 42” wide x 30” high custom fabricated, all-welded 18-gauge stainless steel in accordance with drawing with components/features/accessories as follows:
 - a. Duct extension to 6” above finished ceiling with ceiling trim

- O. Item No. 15 Dishtable w/3-Compartment Sink & Overshelf – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for 30” wide x 16’-3” long x 34” high, length and arrangement as indicated on drawings, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. Three (3) 24” x 30” (left to right) x 14” deep sink compartments
 - b. One (1) splash-mount faucet
 - c. One (1) T&S No. B-0133-ADF12-B pre-rinse with add-on swing faucet
 - d. Two (2) integral drainboard sections as indicated on drawings
 - e. 15” wide x full-length x 24” high cantilevered overshelf w/notch-out for pre-rinse faucet
 - f. Undershelf, except at sinks

- P. Item No. 16 Mobile Utensil Shelving Units (3) – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for Metro Super Erecta series or approved equal, each with components/features/accessories as follows:
 - a. Four (4) 24” wide x 48” long epoxy-coated adjustable wire shelves
 - b. 63” high epoxy-coated tubular uprights
 - c. Four (4) 5” diameter urethane swivel casters, two (2) with brakes

- Q. Item No. 17 Hand Sinks (4) – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for Advance Tabco No. 7-PS-50 or approved equal, each with components/features/accessories as follows:
 - a. Splash-mounted faucet with wrist handles
 - b. Lever drain with overflow
 - c. Chrome-plated “P” trap
 - d. Wall bracket

- R. Item No. 18 Utility Carts (2) – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for Lakeside No. 943 or approved equal

- S. Item No. 19 Work Table w/Overhead Pot Rack – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for 30” wide x 108” long x 36” high, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. Two (2) drawers
 - b. Undershelf
 - c. 12” wide x 8’-6” long pot rack mounted 60” above table top

- T. Item No. 20 Preparation Counter w/Sinks, Overshelf, & Overhead Pot Rack – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for 60" wide x 12'-0" long x 36" high, arrangement indicated on drawings, custom fabricated stainless steel double-sided open base type with components/features/accessories as follows:
 - a. Marine roll edges on front and ends (sink side)
 - b. 6" high x 6" wide x full-length enclosed backsplash with stainless steel cap
 - c. Two (2) 24" x 24" x 12" deep sinks, each with lever handle drains
 - d. Splash-mount faucet
 - e. Four (4) NEMA 5-20R within backsplash, located as indicated on drawings
 - f. Four (4) drawers, as indicated on drawings
 - g. Undershelves, except at sinks
 - h. 12" wide x 11'-6" long cantilevered overshelf and pot rack mounted 24" and 60" respectfully above table top
- U. Item No. 21 Food Processor – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for Robot Coupe No. R401 or approved equal with standard discs
- V. Item No. 22 Mobile Proofer/Warmer – Existing, Contractor Relocated and Installed:
 - 1. Space and utilities for Avantco No. 177HEAT1836I
- W. Item No. 23 Mobile Work Table – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for 30" wide x 72" long x 36" high, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. Drawer
 - b. Undershelf
 - c. Casters
- X. Item No. 24 Baker's Table w/Spice Rack – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for 30" wide x 72" long x 36" high, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. Rear and right end splashes
 - b. Open base to receive mobile ingredient bins
 - c. 12" wide x full-length stainless-steel spice shelf installed on stainless steel tubular uprights 15" above table top
- Y. Item No. 25 Mobile Ingredient Bins – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for Piper No. 47-150 or approved equal
- Z. Item No. 26 30-Quart Mixer – Owner Furnished, Contractor Installed:
 - 1. Space and utilities for Hobart No. HL300-1STD or approved equal with components/features/accessories as follows:
 - a. 30-quart stainless steel bowl, beater, "D" wire whip, "ED" dough hook, and bowl truck
 - b. 72" long NEMA L5-20P cord/plug assembly
- AA. Item No. 27 Spare Number

- BB. Item No. 28 Mobile Hot Food Cabinets (2) – Owner Furnished, Contractor Installed:
1. Space and utilities for CresCor No. H-137-WSUA-12D or approved equal, each with corner bumpers
- CC. Item No. 29 Slicer – Existing, Contractor Relocated and Installed:
1. Space and utilities for Univex No. 8713S
- DD. Item No. 30 Mobile Equipment Stand – Existing, Contractor Relocated and Installed
- EE. Item No. 31 Preparation Counter w/Sink & Overshelf – Owner Furnished, Contractor Installed:
1. Space and utilities for 30” wide x 10’-0” long x 36” high, arrangement indicated on drawings, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. Two (2) drawers, as indicated on drawings
 - b. One (1) 24” x 24” x 12” deep sink
 - c. Splash-mount faucet
 - d. Undershelves, except at sinks
 - e. 12” wide x 9’-6” long cantilevered overshelf mounted 24” above table top
- FF. Item No. 32 Spare Number
- GG. Item No. 33 6-Burner Range w/Oven Base – Owner Furnished, Contractor Installed:
1. Space and utilities for Southbend No. P36D-BBB or approved equal with components/features/accessories as follows:
 - a. Stainless steel front, sides, rear, and 6” high adjustable legs
 - b. 24” high stainless-steel flue riser
 - c. Flame failure protection
 - d. Standard oven
- HH. Item No. 34 Fryer Units (2) – Owner Furnished, Contractor Installed:
1. Space and utilities for Pitco No. SG18-S fryers each with components/features/accessories as follows:
 - a. Standard controls
 - b. No. PP10056 fryer cleaning brush
 - c. No. A3301001 clean out rod
 - d. Stainless-steel tank cover
 - e. 9” adjustable swivel casters, two (2) w/brakes
- II. Item No. 35 30-Gallon Tilting Braising Pan – Owner Furnished, Contractor Installed:
1. Space and utilities for Groen No. BPM-30GC or approved equal with components/features/accessories as follows:
 - a. Classic controls
 - b. No. 150247 pan carrier
 - c. No. Z040602 double-pantry faucet with 48” spray hose
- JJ. Item No. 36 40-Gallon Tilting Kettle – Owner Furnished, Contractor Installed:
1. Space and utilities for Groen No. DH-40C or approved equal with components/features/accessories as follows:

- a. Classic controls
- b. No. 122891 pan carrier
- c. Hinged cover
- d. 2" draw-off valve
- e. No. Z040602 double-pantry faucet with 48" spray hose and kettle filler

KK. Item No. 37 Double Stack Combi-Oven/Steamer – Owner Furnished, Contractor Installed:

- 1. Space and utilities for Rational No. ICP 6-FULL ON 6-FULL NG (CC1GRRA.0000238) or approved equal with components/features/accessories as follows:
 - a. No. 60.75.752 stacking kit
 - b. No. 60.31.203 stationary stand
 - c. Manufacturer-recommended water filtration system

LL. Item No. 38 Utility Distribution System (One Required):

- 1. System shall be a U.L. Listed, modular, island-type energy distribution and control system manufactured in accordance with the latest edition of the National Electrical Code (NEC), National Manufacturer's Association (NEMA), National Fire Protection Association (NFPA) Pamphlet Nos. 96 and 54, Uniform Plumbing Code, ASME, and Occupational Safety and Health Administration (OSHA) using only U.L. Listed Bureau of Mines, and AGA and CGA certified components.
- 2. System shall be 13'-0" long x 8" wide and shall be completely pre-wired and pre-plumbed to final connection points for electric/hot water/cold water/gas for the equipment shown on the drawings. **HORIZONTAL CHASE OF ISLAND-TYPE SYSTEM SHALL NOT EXCEED AN OVERALL HEIGHT (INCLUDING PEAKED TOP) OF 50" ABOVE FINISHED FLOOR.**
- 3. Fixed riser, pedestal, end caps, and raceway exterior panels shall be constructed of 16-gauge type 304 stainless steel with a No. 4 finish. Removable panels shall be constructed of 18-gauge stainless steel. A watertight barrier shall be provided between electrical and plumbing compartments. Control tower pedestals shall be secured to the building floor with stainless steel, interior flanges. Housing of the raceway shall be equipped with neoprene bumper strips.
- 4. Electrical compartment shall be a completely enclosed, stainless-steel housing accessible by removal of stainless-steel screws.
- 5. Internal electrical main feeder(s) shall be cable bus type having balanced load and phases with branch circuit locations directly behind connection plates. Cable bus shall be manufactured from 100% copper and mounted on non-conductive insulators spaced at 48" (maximum) centers and equipped with connection lugs for main service. Field joints shall be connected by attaching cables to insulated terminals. Branch circuit wiring for each electrical connection shall be phase-identified and sized in accordance with circuit breaker's rated ampacity. A 12" long, 16-gauge, stainless steel connection plate shall be provided for each electrical connection and equipped with a point-of-use circuit breaker and grounding type receptacle having a specific NEMA, polarized configuration or pre-wired, flexible, seal-tite conduit. Connection plates shall be equipped with metallic labels with permanently lettered electrical characteristics. Plates shall be spaced on 12" centers and readily interchangeable by maintenance personnel to facilitate changes, additions, and deletions of equipment. Blank plates shall be provided for future equipment. A main electrical circuit breaker and disconnect shall be mounted in the control tower.

6. Plumbing compartment shall be isolated from the electrical compartment and all piping and disconnects shall be color-coded. Provide an additional capped nipple in each section for each plumbing service for future use. Field joints shall be secured by tightening unions.
7. Hot and cold-water piping, including individual branch pipe connections, shall be hard temper type "L" copper tubing with copper sweat type solder fittings. All water lines shall be covered with 3/8" thermal closed cell pipe insulation per ASTM-E90-C. Each branch connection shall be provided with a brass, double shut-off, quick-disconnect, and flexible hose connector consisting of brass bellows type, corrugated hose with braided stainless-steel restrainer. Hoses shall be coated with Avtec Polytec material to provide a smooth surface for cleaning.
8. Gas piping shall be black iron pipe with welded threadlets to branch connections and drip-tee in the service riser. Each branch connection shall be equipped with a quarter-turn, ball-type shut-off valve; brass quick-disconnect; 2-wall, stainless steel, flexible hose connector; and steel restraining cable. Hoses shall be coated with Avtec Polytec material to provide a smooth surface for cleaning.
9. System shall be equipped with quarter-turn shut-off valves for all main incoming services for gas and water.
10. System shall be equipped with components/features/accessories as follows:
 - a. Two (2) end risers
 - b. Two (2) floor pedestals
 - c. T&S No. B-0605-CR Fill Faucet located in end riser adjacent to Item 33
 - d. One (1) duplex convenience outlet on each end tower
 - e. Power shut-off device (shunt trip breaker)
 - f. Exhaust Hood light switch, mounted on end riser panel adjacent to Item No. 30 Preparation Counter
 - g. Exhaust/Supply fan control panel with fire system interface mounted in end riser adjacent to Item No. 13 Dishwashers
 - h. Water quick-disconnect hose assemblies for cooking equipment
 - i. Gas quick-disconnect hose assemblies with shut-off valves for cooking equipment
 - j. Electric cord/plug assemblies for cooking equipment
11. System shall be Avtec MIDG series or approved equal to meet above requirements. Shop drawings are required for approval. Refer to Bases of Design in Contract Document drawings for utility requirements and locations thereof, **Verify Owner Furnished Equipment prior to shop drawings submittal.**

MM. Item No. 39 Exhaust Hood (One Required):

1. Size: 9'-10" wide (including framing section, plus make-up air plenums x 13'-0" long x 30" high)
2. Construction Features: UL 710 Listed (without fire dampers in exhaust collars), constructed of all-welded 18-gauge type 304 no. 4 finish stainless steel on all surfaces with all exterior joints and seams continuously welded liquid tight, ground smooth and polished to a no. 4 finish to conform to the latest edition of NFPA 96. Exterior front and end panels shall include double panes with integral "v" bracing or 16-gauge double panes to strengthen flat surfaces. Hood shall include 3" wide barrier between rear of hood and building wall. UL Listed stainless steel baffle filters extending the entire length of the hood. Grease trough shall be concealed type (fully-enclosed) sloped to one (1) end and equipped with a removable stainless-steel grease cup.
3. Components/Features/Accessories:
 - a. 10" wide framing section between hood sections for risers of Utility Distribution System

- b. Two (2) 14" wide x full-length x 8" high, stainless steel air curtain type double wall insulated make-up air plenums with air balancing dampers, baffles, and duct collars to ensure even air distribution along entire length of plenum
- c. Heat sensors for activation of exhaust fan whenever cooking operations occur in accordance with paragraph 507.2.1.1 of 2006 International Mechanical Code
- d. Ten (10) UL-listed Component Hardware No. LED-L80-20DN recessed-type LED light fixtures with bulbs pre-wired in rigid conduit on top of hood to a junction box on each section of hood
- e. Exhaust/supply fan control panel with fire system interface and light switch mounted on Item No. 38 Utility Distribution System
- 4. Refer to Contract Document drawings for CFM requirements and duct sizes
- 5. Exhaust Hood shall be Avtec AFWO-PBB series or approved equal to meet above requirements
- 6. Shop drawings required for approval.

NN. Item No. 40 Fire Suppression System (One Required):

- 1. System shall be designed to automatically suppress fire by spraying the exhaust hood plenum area, filters, exhaust ducts, and cooking surfaces with a predetermined flow rate of low pH liquid fire suppressant in compliance with the latest editions of NFPA 17A, NFPA 96, and Authority having Jurisdiction. System shall be Ansul R-102 pre-engineered wet chemical type or approved equivalent in compliance with UL Standard 300. System shall include components/features/accessories installed by a manufacturer certified installer as follows:
 - a. Stainless steel nozzles and piping within Exhaust Hood
 - b. Regulated release assembly which contains a release mechanism and agent tank within a stainless-steel enclosed cabinet mounted on building wall where indicated on drawings
 - c. Remote manual release station located on egress of cooking area
 - d. Mechanical (cable-operated) gas shut-off valve (verify size) for installation on incoming gas line at Item No. 38 Utility Distribution System
 - e. Submittal data and review fee by Fire Marshal's Office or Authority having Jurisdiction
 - f. Shop drawing of nozzle layout and finishes required for Design Team review and approval
- 2. This Contractor shall furnish and install a Class K portable fire extinguisher with wall bracket in kitchen in accordance with NFPA 10 and State Fire Marshal requirements.

OO. Item No. 41 Stainless Steel Floor Troughs (Two Required):

- 1. 19-1/2" wide x 36" long, custom-fabricated all-welded 14-gauge type 302/304 stainless steel in accordance with drawings. Trough shall be equipped with 5-1/2" diameter x 3-1/4" deep sump bowl with 3" long pipe sleeve sized to accommodate drain pipe (installed within sleeve) by plumbing contractor. Sump bowls shall be equipped with removable perforated stainless steel strainer baskets with perforated covers. Submit shop drawing for approval.
- 2. Trough shall be equipped with 15-1/4" wide x 31-3/4" long (60" maximum length sections) x 1" thick McNichols No. MS S-100 SM-G dark gray color fire retardant removable molded fiberglass grates (1/4" wide bars with 1-1/2" x 1-1/2" spacings) with grit surface (one side only). Each grate shall be cut with a bar on all outside edges for a banded finished edge appearance. Grates shall be furnished by trough fabricator for fitting coordination purposes. Submit shop drawing for approval.

- PP. Item No. 42 Ice Machine w/Storage Bin – Owner Furnished, Contractor Installed:
1. Space and utilities for Manitowoc No. IDT0500A (air-cooled cuber) with components/features/accessories as follows:
 - a. Water filtration system sized for ice production capacity
 - b. No. D-570 ice storage bin
- QQ. Item No. 43 Spare Number
- RR. Item No. 44 Work Table w/Overshelves and Heat Lamps – Owner Furnished, Contractor Installed:
1. Space and utilities for 36" wide x 12'-0" long x 36" high, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. 18" wide x full-length x 30" high double overshelves
 - b. Four (4) Hatco No. GRAH-66-D3 heat lamps
 - c. Undershelf
- SS. Item No. 45 Reach-In Refrigerator – Existing, Contractor Relocated and Installed:
1. Space and utilities for Atosa No. MBF8507GR
- TT. Item No. 46 Moveable Farmhouse Counter – By Division 8 (Millwork)
- UU. Item No. 46A Drop-In Soup Wells (2) – Owner Furnished, Contractor Installed:
1. Space and utilities for Alto-Shaam No. 1100-RW or approved equal
- VV. Item No. 46B Drop-In Heated Shelf – Owner Furnished, Contractor Installed:
1. Space and utilities for Hatco No. HBGB-2418 or approved equal
- WW. Item No. 46C Food Guard – Owner Furnished, Contractor Installed:
1. Space and utilities for Full-length (6'-4" long - verify) PMG No. FM2R-A series adjustable self-service style food guard with overshelf and LED display light
- XX. Item No. 47 Mobile Salad Top Refrigerator – Existing, Contractor Relocated and Installed:
1. Space and utilities for Delfield No. 4448N-18M-A5
- YY. Item No. 48 Mobile Equipment Stand – Owner Furnished, Contractor Installed:
1. Space and utilities for 24" wide x 24" long x 34" high, custom fabricated stainless steel open base type with components/features/accessories as follows:
 - a. Undershelf
 - b. Four (4) casters w/brakes
- ZZ. Item No. 49 Mobile Panini Counter w/Food Guard – Existing, Contractor Relocated and Installed:
1. Space and utilities for 31" wide x 12'-6" long x 34" high custom fabricated stainless steel enclosed counter with notch-out for Item 47
- AAA. Item No. 50 Panini Sandwich Warmers (2) – Existing, Contractor Relocated and Installed:

1. Space and utilities for Globe No. GPG10

BBB. Item No. 51 Mobile Milk Cooler – Owner Furnished, Contractor Installed:

1. Space and utilities for Traulsen No. RMC49S4 or approved equal with corner bumpers

CCC. Item No. 52 Serving Counter – Owner Furnished, Contractor Installed:

1. Space and utilities for 32" wide x 60" long (verify) x 34" high with arrangement indicated on drawings custom fabricated stainless steel enclosed base type with components/features/accessories as follows:
 - a. Cutouts and provisions for Item No. 53
 - b. Provisions for mounting Item No. 54
 - c. Stainless steel base panels with 3/4" marine plywood front panel w/plastic laminate (verify pattern w/Architect) with hinged doors
 - d. 6" high toe kick
 - e. Stainless steel undershelf
 - f. Shop drawing required for approval

DDD. Item No. 53 Drop-In Chilled Water Dispensers (2) – Owner Furnished, Contractor Installed:

1. Space and utilities for Crysalli No. CR-CPSW-DI or approved equal, each with components/features/accessories as follows:
 - a. Manufacturer-recommended water filter system
 - b. Installation kit

EEE. Item No. 54 Coffee Brewer – Owner Furnished, Contractor Installed:

1. Space and utilities for Bunn No. 23001.0006 or approved equal

FFF. Item No. 55 Microwave – Not In Contract (Owner Furnished and Installed):

1. Space and utilities for ACP No. MFS12TS (verify)

GGG. Item No. 56 Serving Counter – Existing, Contractor Relocated and Installed:

1. Space and utilities for 48" long x 30" wide unit

HHH. Item No. 57 Mobile Salad Bar (Existing):

1. Space and utilities for 72" long x 50" wide unit

PART 3 - EXECUTION

3.1 ERECTION

- A. Equipment specified herein shall be erected and set in place at location as indicated on Drawings. Equipment shall be fabricated so that it can be handled through finished openings or arrangements otherwise made with General Contractor. Equipment specified shall be located on floors as indicated on Drawings. A competent foreman shall be provided as supervisor of erections and installations.

3.2 ADJUSTMENT OF EQUIPMENT

- A. Contractor shall adjust all equipment after erection and installation to satisfaction of Owner.

- B. Contractor shall confirm in writing that all equipment is operational and in working condition prior to demonstration.

3.3 CLEANING OF EQUIPMENT

- A. Clean up all debris caused by workmen immediately upon completion of Work in the area, and clean equipment after all others have completed their Work in the area.

3.4 DEMONSTRATION OF EQUIPMENT

- A. Upon acceptance by Owner, provide full instructions to Owner's designated representative on proper methods of care, operation, and maintenance of equipment.
- B. Three (3) operating instructions, warranty cards/certificates and parts manuals on equipment in loose leaf hard cover binders shall be presented to Architect at this time. Operation and maintenance manuals shall be organized for easy reference by maintenance personnel, including index tabs of equipment item numbers.

END OF SECTION

SECTION 12 36 00
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.
- C. Countertop support brackets with concealed vertical leg.

1.02 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.
- B. Section 09 21 16 - Gypsum Board Assemblies: Coordination of mounting of concealed leg brackets.
- C. Division 22: Sinks.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- D. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
- G. PS 1 - Structural Plywood; 2009 (Revised 2019).

1.04 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. Specimen warranty.

- B. Shop Drawings: Complete details of materials and installation .
- C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- D. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

- A. Fabricator and Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of experience.

1.06 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.

1.07 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.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
 - 1. Flat Sheet Thickness: 3/4 inch, minimum.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) HanStone Quartz in the color Swan Cotton (RS301)
 - b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).

- c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
- d. Finish on Exposed Surfaces: Polished.
- e. Color and Pattern: As indicated on drawings.
- 3. Other Components Thickness: 3/4 inch, minimum.
- 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
- 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
- 6. Skirts: As indicated on drawings.
- 7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.

2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
 - 1. Marine Grade Plywood: Face species Douglas fir or Western larch; veneer core; APA PS-1 Grade A-B; Exterior bond; provide in locations indicated.
 - 2. Particleboard Substrate: Not permitted.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
 - 1. VOC: 70 g/L maximum in accordance with SCAQMD Rule 1168, 2005.
- C. Joint Sealant: Mildew-resistant silicone sealant, clear.
- D. Countertop Brackets: Extruded aluminum, fully welded, 90-deg angle support brackets; concealed vertical leg.
 - 1. Product:
 - a. Rakks; EH-1818FM or comparable product.
 - 2. Finish: Powder coat.
 - a. Color: Black.
 - 3. Coordinate installation with the work of Section 09 21 16 - Gypsum Board Assemblies.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.

1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - a. Rout a 1/8 inch drip groove at underside of exposed overlapping edges, set back 1/2 inch from face of edge.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes. Coordinate cutouts with items specified in Section 06 41 00 - Architectural Wood Casework.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches, unless otherwise indicated.
- C. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.
- B. Verify that concealed-leg brackets have been installed and wall surfaces finished as specified in Section 09 21 16 - Gypsum Board Assemblies.

3.02 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.

3.03 INSTALLATION

- A. Install countertop brackets in accordance with manufacturer's written instructions.
 1. Installation of brackets indicates acceptance of stud gage and installation.
 2. Coordinate installation with the work of Section 09 21 16 - Gypsum Board Assemblies.
- B. Securely attach countertops to brackets with concealed fasteners. Make flat surfaces level; shim where required.

- C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.

3.06 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 12 36 00

SECTION 21 01 00
FIRE PROTECTION OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.02 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect / Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit three (3) completed manuals in final form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect / Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two (2) complete Manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.01 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.01 OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed

- 2) Identify data applicable to installation
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
3. Drawings:
- a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
4. Written text, as required to supplement product data for the particular installation:
- a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued.
- a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure
 - 2) Instances that might affect validity of warranties or bonds
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems.

1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions
 - 2) Performance curves, engineering data and tests
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.

- k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
 - 4. Provide complete information for products specified in Division 21.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.
 - 9. Provide backflow preventer certified test reports.

END OF SECTION 21 01 00

SECTION 21 05 00
FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions and Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 21 Fire Sprinkler Systems.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.02 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.03 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.04 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified

capacities.

1.05 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.06 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible drawings is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex mylar film positives) and AutoCad 2012 / Revit CAD files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, etc. that were deviated from construction drawings.
 - 6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 7. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 9. Exact location of all electrical equipment in and outside of the building.
 - 10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.07 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this

respect.

1.08 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.09 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 21 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.02 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:

1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
2. Chamfer strips at edges and corner of forms.
3. Smooth steel trowel finish.
4. Doweled to existing slab

D. Install concrete curbs around multiple pipe penetrations.

3.03 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. 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.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.04 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
 1. Provide the training during the Owner's regular working day.
 2. The Instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.
- B. Time to be allocated for instructions.
 1. Minimum of 4 hours dedicated instructor time.
 2. 2 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 1. One copy to the Owner.
 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that

instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.05 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.06 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.07 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION 21 05 00

SECTION 21 05 10
FIRE PROTECTION CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.02 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.03 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.04 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.05 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.06 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.

- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.01 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.01 PROTECTION OF EQUIPMENT

- A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION 21 05 10

SECTION 21 05 12

FIRE PROTECTION SHOP DRAWINGS, COORDINATION DRAWINGS AND PRODUCT DATA

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.02 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.03 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}" = 1' - 0"$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment

- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.04 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.05 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.06 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.

- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.07 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier

- d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.08 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.09 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.

- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 21 05 12

SECTION 21 05 13
ELECTRICAL PROVISIONS OF FIRE PROTECTION WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Electrical provisions to be provided as fire protection work are indicated in other Division 21 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as fire protection, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for fire protection equipment.
 - 2. Starters for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar fire protection-electrical devices provided for fire protection systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 21 sections for specific individual fire protection equipment electrical requirements.
- F. Refer to Division 26 sections for motor starters and controls not furnished integrally with fire protection equipment.
- G. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of fire protection equipment.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.03 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of fire protection work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.04 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.01 MOTORS

- A. Provide motors for fire protection equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of fire protection equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of fire protection work:
- C. Temperature Rating. Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 21 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 21 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded

- drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 21 for other enclosure requirements.
4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 5. Noise Rating: Provide "Quiet" rating on motors.

H. All motors shall be premium efficiency.

2.02 EQUIPMENT FABRICATION

- A. Fabricate fire protection equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in fire protection work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION 21 05 13

SECTION 21 10 00
FIRE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Design coordination of sprinkler work with the installations of other trades as shown on their drawings; all mechanical, electrical, plumbing and sprinkler work must fit the space requirements. The sprinkler work shall comply with other Sections of this specification; and fit the structure finishes. The Sprinkler Contractor will comply with all the codes and underwriter authorities, and the requirements for the installation of inside and outside piping; including sprinkler heads, valves, tamper switches, flow switches, hangers and supports, sleeves, fire department connections, inspector test connections, main drain and accessories, signs and any other component parts reasonably incidental to providing a complete protection system. Provide 100 percent coverage for the entire building.
- B. A wet system shall be installed in heated areas and dry pipe systems in areas subject to freezing. When heated areas are not available and dry pipe system not used, provide heat tracing and / or insulation installed per NFPA and per local Fire Marshall Requirements, or as indicated on drawings.
- C. Furnish all articles of a completed sprinkler system including all materials, labor, tools, equipment, transportation services and supervision fees.
- D. The plans provide a riser assembly location at water entry into building for flow switch locations, valve locations (with tamper switches), fire department test assemblies and fire department Siamese connections. These are a guide for subsequent preparation of the Contractor's detailed installation drawings of the complete fire protection sprinkler system which shall be submitted to the Architect / Engineer for review. Submit only drawings and calculations bearing the approval of the authority having jurisdiction.
- E. Do not exceed 52,000 square feet of building for each individual sprinkler system.
- F. Install fire protective system identification signs in accordance with NFPA-13, NFPA-14, and NFPA-20
- G. It shall be the fire protection installer's responsibility to verify pressure at the project site by performing a flow test. Determine if the available static pressure, residual pressure and flow rate will adequately provide the fire extinguishing system with the necessary operating requirements or if a fire pump, storage tank and necessary appurtenances are required. Notify Architect and Engineer if low water flow / pressure condition exist and inform them of all options prior to proceeding.
- H. The installation of the entire Sprinkler Systems shall comply with all rules and regulations of the National Board of Fire Underwriters, the Local Building Code, Local Fire Marshall, and Requirements of NFPA Pamphlet 13, and other local authorities exercising jurisdiction.
- I. Study the general, structural, electrical and mechanical drawings and specifications, in order to become familiar with the building and details as they apply to the work of this

Section. Cooperate with all Trades so that there will be no conflict of space. Plumbing flow lines, large ductwork HVAC piping and electrical service feeders shall take precedence over Fire Protection work, except where it is absolutely necessary to maintain coverage protection.

- J. Provide a water curtain sprinkler system along glazing to create a 1-hour rating, as outlined in NFPA 13. Refer to Architecture plans for locations. Water demand for water curtain shall be added to the ceiling sprinkler water demand at the point of connection, per NFPA 13. Sprinkler heads shall be spaced at 6'-0" o.c., minimum 6 inches and maximum 12 inches from glazing.

1.02 BASIS OF DESIGN

- A. National Fire Protection Association (NFPA), latest edition of NFPA 13, Standard for the Installation of Sprinkler Systems.
- B. Vertical zone valves installed in horizontal position are not acceptable. All zone valves are to be located at water entry into building and mounted in the vertical riser.

1.03 QUALITY ASSURANCE

- A. Sprinkler equipment and installation to be in accordance with recommendations of and approved by local, state and federal fire authorities.
- B. Equipment and installation to meet requirements of NFPA No. 13, 14, 20, 24, 25, 70 and 72.
- C. Use materials and equipment that are new and of unused, approved by NFPA and as listed in the UL list of "Inspected Fire Protection Equipment and Materials."

1.04 SHOP DRAWINGS

- A. Make complete shop drawings and working drawings of equipment furnished, including detailed drawings of piping and sprinkler head locations. Drawings shall show construction details and dimensions of each piece of equipment and work to be installed. The location of all heads shall be as approved. Where additional heads are required to meet NFPA 13, provide at no additional cost.
- B. Before the shop drawings are submitted to Architect / Engineer, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the departments.
- C. The Architect's approval of shop drawings shall not relieve the responsibility of correctly figured dimensions or any errors that may be contained in these drawings. The omission of any material shown on the contract drawings, or specified from the shop drawings, even though approved, shall not relieve the responsibility to furnish and erect them.
- D. Provide ¼ scale drawings to show the location of the water entry into building with all zone valves, and shut-off valves, with alarms and drains at this location. Prepare the sprinkler drawings under the work of this Section.

- E. Submit samples of all sprinkler types for approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Johnson Controls (Tyco Fire Products)
 - 1. Gem/Grinnell
 - 2. Central
 - 3. Star Sprinkler
- B. Automatic Sprinkler Company of America
- C. Potter Roemer, Inc.
- D. The Reliable Automatic Sprinkler Company
- E. Viking Corporation
- F. Victaulic Company of America
- G. Globe Fire Sprinkler Corporation

2.02 PIPING AND FITTINGS

- A. Above Slab Inside Building
 - 1. Pipe 2" and Smaller: Schedule 40, black steel pipe conforming to ASTM A 795 or ASTM A135 joined with threaded fittings.
 - 2. Pipe 2-1/2" and larger, provide ASTM A795 or ASTM A135 UL and FM listed.
 - a. Light wall having a minimum corrosion resistance ratio (CRR) or 1.00 or greater.
- B. Underground within five feet of building. Provide ductile iron pipe, Class 200 conforming to ASTM, and ring-tite fittings. Provide concrete thrust blocks at changes in direction, according to the pipe manufacturer's recommendations.
- C. All piping shall be black carbon steel, except in dry systems where pipe shall be galvanized per ASTM A53.
- D. Fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance to the material and dimension standards listed in table 6.4.1 NFPA 13 and 2.2.1 NFPA 14.

2.03 SPRINKLER HEAD

- A. All sprinklers shall comply with the latest requirements of NFPA 13 with respect to orifice size.
- B. All heads shall be UL listed and/or FM approved, and comply with the latest requirements of NFPA 13 with respect to orifice size unless otherwise noted. Sprinkler heads with "O" ring design shall not be acceptable.

- C. Exposed areas:
 - 1. Standard upright type with brass finish and escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.
 - 2. Tyco Model B, FRB, Globe Model GL-QR, GL-SR, or approved equal
- D. Sidewall applications:
 - 1. Horizontal sidewall type with brass finishes and chrome escutcheon.
 - 2. Unfinished areas and recessed with chrome plated escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.
 - 3. Tyco Model B, FRB, Globe Model GL-QR/SW, GL-SR/SW, or approved equal.
- E. Suspended ceilings:
 - 1. Adjustable drop down deflector type concealed heads with manufacturer painted white cover plate with glass bulb fusible link. Provide temperature rating per NFPA 13 and UL/FM approvals.
 - 2. Color of plate, selected by Architect
 - 3. Tyco Series RFII; Series ELOC, Globe Concealed Models GL-QR/INCH, GL-SW/INCH and GL-INCH/ECLH or approved equal.
- F. Dry sprinklers heads at freezers and coolers
 - 1. Tyco Model DS-1, DS-2, or approved equal.
- G. Sprinklers subject to mechanical injury shall be protected with fusible solder type sprinklers and listed heavy duty bolt on guards. Bulb type sprinklers will not be acceptable for these locations.
 - 1. Storage rooms with exposed structure.
 - 2. Mechanical and Electrical rooms.
 - 3. Below exposed stairs.
 - 4. Exposed structure areas.
- H. Systems serving walk-in freezers shall utilize Tyco Model DS-1 or DS-C dry pendent sprinklers. A Model DSB-1 dry sprinkler boot shall be utilized in conjunction with the dry sprinkler to eliminate the requirement for insulation and to stop potential air interchange. Length of dry pendent shall be determined by manufacturer's recommendation with respect to freezer ambient temperatures expected.

2.04 INSPECTOR'S TEST CONNECTION

- A. Provide inspector's test connection as required by NFPA 13.
 - 1. Ductile iron module housing with combination sight glass, orifice and bonnet assembly
 - 2. UL listed
 - 3. Victaulic No. 718
 - 4. Globe Model UTD
 - 5. Tyco, or approved equal

2.05 TAMPER SWITCH / SUPERVISORY SWITCH

- A. Tamper switch on each valve
 - 1. Controlling or shutting off sprinkler system or any portion thereof.

2. Tamper switch with either one single pole, double throw switch or two single pole, double throw switches as required.
3. Switch shall be compatible with installed valve for standard mounting.
4. Potter-Roemer Fig. 6220, 6221, 6222, 6223 or approved equal.

2.06 FLOW SWITCH

- A. Vane type flow switch.
 1. Self-contained pneumatic, adjustable retard.
 2. Two, single pole, double throw switches.
 3. Red enamel tamper proof switch housing with flow paddle.
 4. Potter Roemer Model No. 6200, or approved equal.

2.07 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.10 GASKETS

- A. Use 1/16-inch thick preformed synthetic rubber bonded.

2.11 COUPLINGS

- A. Use listed rolled grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Coupling consists of ductile iron housing, c-shaped composition sealing gasket and steel bolts. Gasket Material for dry pipe systems shall be silicone and listed for dry pipe service.

2.12 VALVES

- A. Use valves suitable for 175 psig WOG.
- B. Valves to be UL listed and FM approved.
- C. Valve Connections:
 1. Provide valves suitable to connect adjoining piping as specified for pipe joints. Use full line size valves unless noted otherwise.
 2. Screwed ends for pipe sizes 2 inches and smaller.
 3. Flanged ends for pipe sizes 2-1/2 inches and larger.
 4. Solder or screw to solder adapters for copper tubing.
 5. Use grooved body valves with mechanical grooved jointed piping.
- D. Gate Valves:
 1. Up to 2 inches, bronze, outside screw and yoke, rising stem, solid wedge, screwed ends, manufactured by: Mueller, or approved equal.
 2. Over 2 inches, iron body, bronze trim, outside screw and yoke, rising stem, solid wedge, flanged ends; manufactured by Mueller, or approved equal.

- E. Check Valves:
 - 1. Up to 2 inch, bronze, regrind bronze swing disk, solder or screwed ends; 200 WOG, manufactured by Mueller, or approved equal.
 - 2. Over 2 inch, iron body bronze trim, swing disk, regrind – renew bronze disk and seat, flanged ends; 200 WOG, manufactured by Mueller, Globe Model RCV, or approved equal.
- G. Freestanding Indicating Post: Install adjustable indicating post and valve outside building where shown on Civil drawings, consisting of UL/FM, non-rising stem gate valve and indicating post. Gate valve shall be iron body, non-rising stem, bronze mounted. Indicator flange, 175-psi non-shock rating, flanged end. Indicator shall be UL/FM approved cast iron body, Plexiglas window and 18-inch adjustment span with handle and tamper switch wired to main fire alarm control panel, manufactured by Mueller, Valve No. A-2052, Indicating Post No. A20800, or approved equal.

2.13 ELECTRIC ALARM BELL

- A. 10-inch round red enamel steel bell with electrically operated vibrating outdoor alarm bell, UL listed, red enamel steel, manufactured by Simplex, or approved equal.

2.14 GAUGES

- A. Gauges shall be bourdon tube type with minimum 4-1/2 inch dial and die cast aluminum case with screwed ring and black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube, brazed at socket and tip. The accuracy of the gauge shall be within one-half of one percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure and compound gauges shall have suitable scale ranges and graduations. Suitable for temperatures up to 120 degrees F.
- B. Gauges shall have 1/4 inch connections and be mounted with combination stop / snubber needle valve with suitable pressure rating. Scale ranges: 0-200 psi.
- C. Gauge range shall be such that system normal operating pressure falls with 25 percent and 75 percent of the full-scale range.
- D. Pressure scale graduations shall read in psig. Figure intervals shall be in – 20 psig increments, with minor divisions in 2 psig increments.
- E. The accuracy of the gauge shall be at least 0.5 percent of the scale range. Gauge shall be made in accordance with ASME B40.1 accuracy grade 2A.
- F. Manufactured by:
 - 1. Trerice Model No. 4500 Series
 - 2. Ashcroft
 - 3. Marsh
 - 4. Weksler

2.15 SPARE SPRINKLER HEAD BOX

- A. Provide baked enamel steel box to store 36 sprinkler heads (Minimum of 3 of each type used) for emergency replacement. Provide sprinkler wrench.

2.16 ALARM CHECK VALVE

- A. Provide UL listed check valve.
 - 1. Variable for City Supplied systems pressure trim set.
 - 2. Constant for Fire Pump Systems pressure trim set.
 - 3. Tyco AV-1, Globe Model H, or approved equal.

2.17 WATER MOTOR ALARM

- A. Provide a red enamel motor alarm for installation on exterior wall.
 - 1. Tyco Model WMA-1, Globe Model WM, or approved equal.

2.18 SIAMESE FIRE DEPARTMENT CONNECTION

- A. Free Standing Fire Department Connection. Furnish rough chrome plated body with polished chrome plated body with polished chrome plated trim sized 4"x2-1/2" x 2-1/2" similar to Potter-Roemer Fig. 5761.

PART 3 - EXECUTION

3.01 DESIGN

- A. Design, spacing of sprinkler heads and selection sizes shall conform to the requirements of NFPA 13 for the indicated occupancy.
- B. Uniform discharge density design shall be based on hydraulic calculations using the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform to NFPA 13.
- C. Friction losses in pipe will be based on a value of "C" = 120 in the Hazen and Williams formula.
- D. Design and install the system so that no part will interfere with doors, windows, heating, mechanical, lighting or electrical equipment. Do not locate sprinkler heads closer than 3 feet to lighting fixtures or other obstructions.

3.02 LOCATION

- A. Heads shown, if indicated on reflected ceiling plans, are an integral part of the ceiling design. Where heads are not shown or indicated, locate them in the exact center of acoustical ceiling tile unless noted otherwise. In rooms with monolithic plaster or gypsum drywall ceilings, locate the sprinkler heads symmetrically arranged with respect to both axes of the room. Locate sprinkler heads in relation to specialty ceiling elements such as slats, ribs, panels, grids, etc., if not shown on the drawings. Generally, locate heads in the exact center of, or spaced between, such elements. Center heads in corridors.

- B. Locate heads as may be required for coordinated ceiling pattern, even through number of heads exceed minimum code requirements.
- C. Sprinkler heads located in utility or mechanical rooms, penthouses, service corridors, or other such spaces not subject to public view need not be centered in ceiling patterns and may use a straight drop from branch line.
- D. Install a water curtain sprinkler system along glazing to create a 1-hour rating, as outlined in NFPA 13. Refer to plans for locations. Water demand for water curtain shall be added to the ceiling sprinkler water demand at the point of connection, per NFPA 13. Sprinkler heads shall be spaced at 6'-0" on center, minimum 6 inches and maximum 12 inches from glazing.
- E. Where glazing shall be installed in 2-hour fire rated assemblies, the Tyco Window sprinkler shall be utilized as outlined in the ICC Legacy report equivalency requirements. Any glazing requiring fire exposure protection shall also utilize the Tyco window sprinklers.

3.03 PREPARATION

- A. Ream pipes and tubes, clean off scale, rust, oxide and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
- B. Pipe beveled each end, per approved procedures.
- C. Hammer clean and flush out piping after welding to remove scale, welding slag and other debris.

3.04 CONNECTION

- A. Make screwed joints with square, clean full cut standard taper pipe threads. Ream after cutting and threading. Red lead and linseed oil or other approved non-toxic joint compound applied to male threads only.
- B. Nipples: Shoulder type; extra heavy where less than 1-1/2 inch is unthreaded.
- C. Clamp cast iron water pipe at fittings with 3/4 inch rods and properly anchor and support.
- D. Use grooved mechanical couplings and mechanical fasteners only in accessible locations.

3.05 COORDINATION

- A. Coordinate the installation schedule for this work with the construction schedule for the Work to ensure orderly progress with minimum delay.
- B. Coordinate interface of fire sprinkler system with the work of other trades to ensure proper and adequate provision for the installation and connection of this system.
- C. Coordinate location and quantity of Siamese connections required for fire department connection with Architect and local fire officials.

3.06 SURFACE CONDITIONS

- A. Before starting each stage of the fire sprinkler systems installation, inspect the installed work of other trades and determine that work is complete enough to allow installation to begin. Ensure that work of other trades has been installed in a manner to permit work of this Section in accordance with approved design.

3.07 INSTALLATION

- A. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads.
- B. Protect sprinkler heads against mechanical injury with heavy duty bolt-on guards.
- C. Locate system drains and inspector's test connections in utility rooms, mechanical rooms or other readily accessible areas not requiring access through ceiling. Coordinate sprinkler system drain flow rates with plumbing system drainage capacities.
- D. Where low points or drains occur above ceilings or in otherwise finished spaces, furnish drain valve with brass cap and chain.
- E. Locate outside alarms on wall of building and coordinate with Architect.
- F. Fire pump and all accessories shall be tested in accordance with NFPA 20 and the local Fire Marshall and/or all other authorities having jurisdiction.
- G. Provide on interior wall near sprinkler valve, cabinet containing extra sprinkler heads of each type and wrench suitable for each head type.
- H. Provide a minimum 18-inch radius swing joint for each drop to sprinkler heads located in ceilings.
- I. Provide Easy-Flex or Flexhead Industries sprinkler hose fittings for each sprinkler head installation for hydraulically designed wet, pre-action, deluge or dry pipe sprinkler connections per NFPA 13. Allow a 3" minimum bend radius per UL Guidelines and a 7" minimum bend radius per FM Guidelines. Hose assembly length shall be 2'-0", 3'-0" or 4'-0" minimum for 1/2" or 3/4" outlet size.
- J. Install pipe markers to identify fire protection.
- K. Provide shield or deflector for sprinklers or equipment where electrical switchgear, switchboards and motor control centers are in sprinkler protected spaces.
- L. Install fire 2-1/2 inch department valve, maximum 5 feet above floor, complying with NFPA 14.
- M. During construction, make one standpipe outlet available on each floor without delay, for fire department use.
- N. Provide 3-way standpipe outlets above roof.

- O. Provide pressure gauges at the top of each standpipe as detailed on the drawings.
- P. Provide drain for each standpipe.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Sprinkler heads shall be installed above and below ductwork over 48 inches wide, in exposed areas, per NFPA 13.
- S. Install the complete fire sprinkler system in accordance with the approved shop drawings.
- T. Perform piping installation in accordance with the provisions of the specifications, including furnishing of required sleeves for fire sprinkler system pipes passing through rated walls, floors, and other parts of the building. Provide scheduled 40 galvanized pipe sleeve for concrete or CMU penetrations. Furnish size required for fireproofing and or insulation. Furnish and install split wall plates and chrome plated escutcheons for exposed fire sprinkler system pipes. Where pipes pass through concrete floors, furnish and install wrought iron or steel pipe sleeves made flush with the ceiling below and extending 2" above the finished floor.
- U. Do not cut or make holes in any part of the building except where shown on the approved shop drawings.
- V. Furnish and install, next to the sprinkler riser main, a print sheet protected by glass or a transparent plastic cover, giving brief instructions regarding control, emergency procedure, and other data required by NFPA #13. For hydraulically designed sprinkler systems, a placard is to be permanently attached to the riser indicating the location, and the basis of design (discharge density and system demand).
- W. Do not install exposed piping below structure in public area.
- X. Provide heat tracing and insulation on wet piping systems exposed to freezing when not installed in a heated space or installed by other acceptable methods of maintaining the piping from freezing. Installation of heat tracing and insulation shall be in accordance with the latest edition of NFPA 13 and the local code authorities. Coordinate electrical requirements with Division 26.

3.08 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.
- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed.

- D. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Steel Max. Support Spacing, Feet	Minimum Rod Diameter, Inches
1" & smaller	6	1/4
1-1/4" & 1-1/2"	8	1/4
2"	10	1/4
3"	10	3/8
4" & 5"	10	1/2
6" and above	10	5/8

3.09 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Ring type clevis hangers are not acceptable. All parts shall be zinc plated carbon steel, or galvanized.

3.10 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.

- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.11 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.

3.12 FLUSHING AND TESTING

- A. Testing and flushing of installation of sprinkler system shall be in accordance with NFPA 13, and NFPA 25.
- B. Flush sprinkler piping in accordance with NFPA 13. Additionally, flush all alarm valves, and all main piping up to valve.
- C. In addition to NFPA 13 required tests, provide flow switch test and tamper switch test for each device, and verify alarm valve operation.
- D. All tests shall be witnessed by Architect / Engineer. Contractor shall notify Architect / Engineer 7 working days in advance.

3.13 EXCAVATING, TRENCHING, AND BACKFILLING

- A. Perform excavation, trenching, and backfilling for this portion of the work in accordance with the specifications.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:

1. Both sides of penetrations through walls, floors and ceilings.
2. Close to valves or flanges.
3. Intervals on straight pipe runs not to exceed 50 feet
4. Apply marker where view is obstructed.

- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

3.15 TESTING AND ACCEPTANCE

- A. Prior to connecting to the overhead sprinkler piping, flush the underground main. Secure required approvals of the flushing operations.
- B. Upon completion of the fire sprinkler system installation, test and retest the complete installation and make corrections as necessary to obtain acceptance by the Fire Marshall and/or any other authority having jurisdiction. Furnish test equipment and personnel required.

3.16 TRAINING

- A. At a time mutually agreed upon, provide 4 hours of instruction to the Owner's designated personnel on the operation and maintenance of the automatic sprinkler system and associated equipment. Owner's Operation and Maintenance Manual prepared for this project shall be used during the instruction.

END OF SECTION 21 10 00

SECTION 21 31 13
FIRE PUMP SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide and install one packaged fire pump system, including a horizontal split case, centrifugal fire pump complete with motor, controller, and accessories as outlined.

1.02 RELATED WORK

- A. Division 23, Mechanical.

1.03 STANDARDS

- A. Make the installation in accordance with applicable requirements of National Fire Protection Association (NFPA) pamphlets, Factory Mutual, and any requirements of state or local authorities.
- B. Furnish equipment and materials approved by NFPA and UL.

1.04 REQUIREMENTS

- A. The Contractor shall provide and install a packaged fire pump system, designed in accordance with the requirements of NFPA Pamphlet #20. The system manufacturer will assume unit responsibility for the proper operation of the entire packaged system as specified herein.
- B. The Fire Pump manufacturer shall have a quality management system in place and shall be ISO 9001 Certified.

1.05 SHOP DRAWINGS

- A. Make complete shop drawings and working drawings of equipment furnished, including detailed drawings. Submittal data for the pumping system shall include, but is not limited to: pump curves, individual computer data sheets, system drawings, and complete description of control panel with wiring diagram, sequencing data, instrumentation, alarms, and a copy of certification of \$1,000,000.00 minimum liability insurance.
- B. Before the shop drawings are submitted for approval, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the departments.
- C. The Architect's approval of shop drawings shall not relieve the responsibility of correctly figured dimensions or any errors that may be contained in these drawings. The omission of any material shown on the contract drawings, or specified from the shop drawings, even though approved, shall not relieve the responsibility to furnish and erect them.

1.06 FACTORY TEST

- A. All equipment will be factory tested in accordance with the requirements of NFPA, UL and

FM. Additionally the entire packaged system will be hydrostatically tested by the system manufacturer prior to shipment.

PART 2 - PRODUCTS

2.01 DESIGN

- A. The pump shall also deliver not less than 150% of rated capacity at a pressure not less than 65% of rated pressure. Provide shutoff pressure not to exceed 120% of the rated pressure. Hydrostatically test the pumps to twice the working pressure, but not less than 250 psig. Mount the pump and driver on a common base plate of fabricated steel. Connect the pump and driver directly through a flexible coupling. As driver, furnish a horizontal induction electric motor of open, drip-proof type

2.02 PUMP

- A. The pump shall be vertical inline, class 40, cast iron, bronze fitted, centrifugal fire pump listed by Underwriters Laboratories and/or approved by Factory Mutual (UL/FM).
 - 1. The unit shall be a Patterson 8" suction x 6" discharge, Model 8X6MI
 - 2. The unit shall be mounted on a fabricated steel base, complete with coupling, OSHA approved, coupling guard, and directly connected to the motor.
 - 3. The pump shall be clockwise rotation as viewed from the driver end.
 - 4. The pump discharge flange shall be rated for 125 lbs
 - 5. The pump casting shall be smooth, free of scale, lumps, cracks, sand holes and defects of any nature which may make it unfit for the use for which it is intended.
 - 6. The bolting of pressure-holding castings shall be such that the maximum stress on any bolt will not exceed $\frac{1}{4}$ the elastic limit of the material as computed by using the stress area and on the basis of the water pressure equivalent to the shutoff pressure effective over the area out of the center line of the bolts.
 - 7. The pump bearings shall have an L-10 rating of not less than 5000 hours based on load ratings and fatigue life.
 - 8. The shaft shall be sealed with a stuffing box and packing with external water-seal piping. The stuffing box glands shall exert uniform pressure on the packing.
 - 9. Bearing housing supports, and suction and discharge flanges shall be integrally case with the lower half of the casing. Removal of the upper half of the casing must allow the rotating element to be removed without disconnecting the suction and discharge flanges. Replaceable shaft sleeves shall be furnished and are to be of bronze ASTM-A148 material. The shaft sleeves shall be held in position by the impeller key and locked in position by a separate threaded sleeve nut.
 - 10. Water slingers of corrosion-resistant material shall be provided to seal the bearings at their inner ends.
 - 11. The pump casing shall be hydrostatic strength-tested to a minimum of 250 psi, or not less than twice the maximum shut-off pressure.

2.03 DRIVER

- A. The motor shall be 125 HP, 1775 rpm, 3 phase, 60 cycle, 480 volt, horizontal open Dripproof motor with a 1.15 service factor.

2.04 FIRE PUMP CONTROLLER WITH TRANSFER SWITCH

- A. The controller shall be a Hubbell Model LX2100, UL/FM labeled combined manual and automatic type designed for soft start / soft stop.
 - 1. NEMA Type 2 enclosure
 - 2. The fire pump controller and transfer switch shall be a single factory wired unit meeting the requirements of the most recently mandated edition of NFPA 20 and shall be listed by Underwriter's Laboratories and approved by Factory Mutual Research Corporation. Both shall bear the labels of UL, ULC, CSA, FM and NYB of S and A.
- B. The minimum withstand rating of the controller shall not be less than 100,000 Amps RMS Symmetrical at 480 V.
- C. The controller manufacturer shall provide a five year warranty to include all parts and replacement labor covering the controller power circuit components, including isolating switch, circuit breaker, current sensing module and motor contractors.
- D. The isolating disconnect switch and circuit breaker shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism.
- E. The controller shall have a minimum running period timer set for 10 minutes. Terminals shall be provided to field convert the controller from automatic to manual shutdown.
- F. The Controller shall have externally mounted individual visible indicators for:
 - 1. Power available
 - 2. Low Pressure
 - 3. Local start
 - 4. Remote start
 - 5. Deluge valve open
 - 6. Phase failure
 - 7. Phase reversal
 - 8. Interlock on
 - 9. Pump running
 - 10. Run timer on
- G. The controller shall be supplied with duplicate, individual Phase Failure, Phase Reversal and Pump Operating alarm contacts.
- H. The power transfer switch shall be designed for use with generator set emergency power source. The power transfer switch shall include a motor rated disconnect / isolating switch capable of interrupting the motor locked rotor current. The disconnect / isolating switch shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism.
- I. The transfer switch circuitry shall be capable of sensing both the normal power source and the emergency source. The normal power source pickup shall be set to pickup at 90% nominal voltage and 95% nominal frequency. All voltage sensing, frequency sensing, and time delays shall be field adjustable. The transfer signal shall be delayed for one second, delaying the transfer and engine start signals so as to override momentary normal power outages.

- J. The transfer switch shall have the following mounted on the flange of the enclosure:
 - 1. Transfer switch normal pilot light
 - 2. Transfer switch emergency pilot light
 - 3. Emergency Isolating switch off pilot light
 - 4. Test switch
 - 5. Transfer bypass switch
 - 6. Audible Alarm pushbutton
 - 7. Silence Alarm pushbutton
- K. The transfer switch shall be electrically operated and mechanically held, and shall be capable of being operated by a manual transfer mechanism located on the switch.

2.05 PUMP ACCESSORIES

- A. ½" automatic air release valve
- B. 4-1/2" suction and discharge gauges
- C. ¾" Casing Relief Valve
- D. 6" x 8" Concentric Discharge Increaser (125 lb)
- E. 8" outside hose valve header (125 lb)
- F. Six 2-1/2" hose valves with caps and chains

2.06 JOCKEY PUMP

- A. The jockey pump controller shall be a Patterson Model FPJP complete with fusible disconnect, Hand-Off-Automatic selector switch and a pressure switch. The controller shall be rated for 2 HP, 3 Phase, 60 Cycle, 460 Volt operation.
- B. The minimum enclosure rating shall be NEMA Type 2, driptight.

PART 3 - EXECUTION

3.01 FACTORY FABRICATION

- A. All of the above equipment will be mounted on an open structural steel I-beam skid. All piping, pressure sensing lines, pump by-pass, shut-off valves, stuffing box and casing relief valve drains will be firmly anchored to the steel base by means of structural steel supports. All electrical wiring between controllers and drivers will be completed and tested at the factory. The entire package will require one power connection by the electrical contractor.

3.02 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions.

3.03 FIELD ACCEPTANCE AND START-UP SERVICE

- A. The service of a factory-trained representative shall be made available on the job site to check installation, field acceptance testing, start-up and instruct operating personnel.
- B. In order to ensure the fire pump unit is properly coordinated and will function in accordance with the intent of these specifications, all the equipment required to comprise the fire pump unit will be supplied by the fire pump manufacturer in whom shall be vested unit responsibility for the proper function of the complete fire pump unit including the fire pump, motor or engine, base plate, control equipment and other required accessories.
- C. To verify compliance with this requirement, the fire pump manufacturer will be required to submit a notarized Certificate of Compliance certifying that all components of the fire pump unit were in fact supplied by the fire pump manufacturer and acknowledging its responsibility for the proper function of the unit.

3.04 GUARANTEE

- A. The packaged fire pumping system shall be guaranteed in writing, by the manufacturer for a period of one year from date of shipment against defect in design, material or construction.

END OF SECTION 21 31 13

SECTION 22 01 00
PLUMBING OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.02 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit three (3) completed manuals in final form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two (2) complete Manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.01 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.01 OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer.
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement.
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.

- 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds.
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems.
 1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts.
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.

- l. Charts of valve tag number, with location and function of each valve.
- m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
- n. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 22.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.
10. Provide gas piping pressure test reports.

END OF SECTION 21 31 13

SECTION 22 05 00
PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.02 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.03 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.04 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.05 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.06 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex mylar film positives) and AutoCad 2012 / Revit CAD files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground plumbing and flow line elevation.
 - 7. Indicate exact location of all underground plumbing piping and elevation.
 - 8. Indicate exact location of all underground electrical raceways and elevations.
 - 9. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 12. Exact location of all electrical equipment in and outside of the building.
 - 13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 15. Cloud all changes.

1.07 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this

respect.

1.08 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.09 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.02 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the

- drawings
- 2. Chamfer strips at edges and corner of forms.
- 3. Smooth steel trowel finish.
- 4. Doweled to existing slab

D. Install concrete curbs around multiple pipe penetrations.

3.03 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. 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.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.04 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of _____ hours dedicated instructor time.
 - 2. _____ hours on each of _____ days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours

devoted to the demonstration, with a list of people present.

- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.05 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.06 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.07 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION 22 05 00

SECTION 22 05 10
PLUMBING CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.02 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.03 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.04 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.05 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.06 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.

- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.01 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.01 PROTECTION OF EQUIPMENT

- A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION 22 05 10

SECTION 22 05 12
PLUMBING SHOP DRAWINGS, COORDINATION DRAWINGS AND PRODUCT DATA

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.02 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.03 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}" = 1'-0"$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment

- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.04 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply, "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.05 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.06 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents

- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect/Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect/Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect/engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.07 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor

- b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
- 1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.08 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
- 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.09 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
- 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.

- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT/ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect/Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect/Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED

END OF SECTION 22 05 12

SECTION 22 05 13
ELECTRICAL PROVISIONS OF PLUMBING WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Electrical provisions to be provided as plumbing work are indicated in other Division 22 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as plumbing, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for plumbing equipment.
 - 2. Starters for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar plumbing-electrical devices provided for plumbing systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 22 sections for specific individual plumbing equipment electrical requirements.
- D. Refer to Division 26 sections for motor starters and controls not furnished integrally with plumbing equipment.
- E. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of plumbing equipment.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.03 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of plumbing work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.04 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.01 MOTORS

- A. Provide motors for plumbing equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of plumbing equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of plumbing work:
- C. Temperature Rating. Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 22 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 22 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 22 for other enclosure requirements.

4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: Provide "Quiet" rating on motors.

H. All motors shall be premium efficiency.

2.02 EQUIPMENT FABRICATION

- A. Fabricate plumbing equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in plumbing work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION 22 05 13

SECTION 22 05 15
PLUMBING EARTHWORK

PART 1 - GENERAL

- A. Excavate and backfill for pipe trenches for underground piping, and excavate for structures installed as part of plumbing work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Excavate trenches for underground piping to the required depth to ensure 2 foot minimum coverage over piping.
- B. Cut the bottom of the trench or excavation to uniform grade.
- C. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp well.
- D. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.

3.02 BACKFILL

- A. Backfill shall not be placed until the work has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
- B. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in 8 inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
- C. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- D. Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe.

3.03 DISPOSAL OF EXCESS MATERIAL

- A. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by the Owner/Architect.

END OF SECTION 22 05 15

SECTION 22 05 17
PLUMBING ACCESS DOORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, regulating devices, water arresters and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.01 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock & cylinder lock for Owner selection
- E. Prime coat finish
- F. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation
- G. Material suitable for wall and/or ceiling mounting

2.02 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish
- J. Material suitable for wall and/or ceiling mounting

2.03 ACCEPTABLE MANUFACTURERS

- A. Milcor
- B. MIFAB
- C. Acudor
- D. Elmdor

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Access doors specified in Division 22 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 24" x 24" for plumbing multiple isolation valves and electrical related items in ceilings
 - 2. 8"x8" for plumbing for single isolation valve or shock arrestor

END OF SECTION 22 05 17

SECTION 22 05 23

VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Plumbing Valves
- B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.01 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450 deg. F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Liners, inserts and discs shall be suitable for the intended service.
 - 3. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.
 - 4. All valves for domestic use must be lead free.
- C. Balancing Valves (Manual)
 - 1. Provide balancing valves with:
 - a. Corrosion resistant plug with resilient seal when required.
 - b. O-ring stem seal.
 - c. Permanently lubricated, corrosion resistant bearings.
 - 2. Connections
 - a. Through 2-inch pipe size use threaded connections.
 - b. For valves 2-1/2-inch pipe size and larger shall be provided with 150 psig flange connections.
 - 3. Provide each valve with:
 - a. Memory stop.
 - b. Plastic drip cap.
 - c. 1/8-inch gauge tap.
 - 4. All valves for domestic use must be lead free.
- D. Thermal Balancing Valves (adjustable Temperature)
 - 1. Adjustable thermal balancing valve used for automatic balancing of circulation circuits in domestic hot water systems. Modulates flow rate in each circuit so hot water temperature at fixtures remains constant.
 - 2. Standards:

- a. NSF/ANSI/CAN 372 low-lead laws, as certified by ICC-ES
 - b. NSF/ANSI/CAN 61, commercial hot water 180 deg. F. as certified by ICC-ES
 - c. Meets codes IPC and UPC
 3. Maximum Working Pressure: 230 psig
 4. Body Material: DZR low-lead brass. Connections: NPT female threaded
 5. Hydraulic Seals: Peroxide-cured EPDM.
 6. Adjustable Balancing Cartridge: Stainless steel and copper.
 7. ABS Adjustable Knob: Temperature adjustment scale for manual setting and tamper-proof adjustment locking screw.
 8. Factory Setting: 130 deg. F.
 9. Outlet Temperature gauge: 2-inch diameter with optional dual-scale outlet, 30 to 180 deg. F.
 10. Check Valve.
 11. Isolation Ball Valves: Inlet and outlet low-lead brass.
 12. Manufacturers:
 - a. Caleffi
 - b. ThermOmegaTech
 - c. Viega
- E. Thermal Balancing Valves (Fixed Temperature)
 1. Static balancing valve with integral flow meter and site gauge, combined with built in temperature gauge and check valve. Designed for balancing domestic hot water circulation systems.
 2. Standards: NSF/ANSI/CAN 372 low-lead laws, as certified by ICC-ES.
 3. Maximum Working Pressure: 150 psig.
 4. Working Temperature Range: 14 to 230 deg. F.
 5. Valve Body, Flow Meter Body and Headwork: DZR low-lead brass.
 6. Ball and Flow Meter Springs and Bypass Valve Stem: Stainless steel.
 7. Ball Control Stem: Brass, chrome plated.
 8. Ball Seal Seat: PTFE
 9. Control Stem Guide, Flow Meter Float, and Indicator Cover: Polysulfone
 10. Built-In Direct Reading Flow Meter:
 - a. Detachable bypass channel for cleaning or replacement.
 - b. Memory sliding pointer providing flow rate memory indication.
 11. Seals: Peroxide-cured EPDM
 12. Ball/Magnet Flow Indicator: Sealed, isolated chamber, not in contact with system fluid to provide clear, accurate readings.
 13. Outlet Temperature Gauge: 30 to 210 deg. F., 2-inch diameter dual-scale temperature gauge.
 14. Insulation shell
 15. Isolation Ball Valves: Inlet and outlet low-lead brass
 16. Manufacturers:
 - a. Caleffi
 - b. Legend Valve & Fitting, Inc.
 - c. TACO Comfort Solutions, Inc.
- F. Ball Valves
 1. Provide ball valves with:
 - a. Blowout proof stem.

- b. Full size port, 316 stainless steel ball and stem.
- c. Cast bronze body.
- d. Threaded ends.
- 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
- 3. Service rating:
 - a. 150 psi saturated steam.
 - b. 600 psi WOG.
- 4. Provide with memory stop for balancing valves.
- 5. Where Viega ProPress fittings are used, Viega ProPress ball valves may be used.
- 6. All valves for domestic use must be lead free.

G. Gate Valves

- 1. Gate valves shall be designed for repacking under pressure when fully opened. Equipped with packing suitable for the intended service.
- 2. When the valve is fully opened, the back seat shall protect the packing and the stem threads from the fluid.
- 3. All gate valves shall have a gland follower.
- 4. Provide solid wedge type gate valves designed and manufactured so that seating surfaces are prevented from contacting until near the point of closure.
- 5. Provide a malleable hand-wheel for all gate valves.
- 6. Provide bronze body, bronze trim, non-rising stem, hand-wheel, inside screw, single wedge or disc, threaded ends up to 2 inches.
- 7. Provide iron body, bronze trim, rising stem, hand-wheel, OS&Y, double wedge, flanged ends over 2 inches.

H. Globe and Angle Valves

- 1. Bronze body 2 inches and smaller, bronze plug disc and renewable seat ring, union bonnet, malleable iron hand wheel, standard packing with bronze gland follower.
- 2. Iron body 2-1/2 inches and larger, bronze mounted disc and bronze seat ring, outside screw and yoke, standard packing with gland follower.
- 3. Globe valves shall be designed for repacking under pressure when fully opened.
 - a. Equipped with packing suitable for the intended service.
- 4. When the valve is fully opened, the back seat shall protect the packing and the stem threads from the fluid.

I. Valve Connections

- 1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
- 2. Thread pipe sizes 2 inches and smaller.
- 3. Flange pipe sizes 2-1/2 inches and larger.
- 4. Use screw to solder adapters for copper tubing.
- 5. Use grooved body valves with mechanical grooved jointed piping.
- 6. Use press valves when using copper press systems.

J. Valve Operators

- 1. Provide suitable hand-wheels for gate, globe, angle or drain valves and inside hose bibbs.

2. When cocks and valves are furnished with square head stem:
 - a. Provide one wrench for every ten cocks or valves sized 2 inches and smaller, minimum of two.
 - b. Provide each cock or valve size 2-1/2 inches and larger with a wrench with setscrew.
 3. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6 inches and larger.
 - b. Where valves are located 7 feet or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5 feet above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4 inches and smaller.
- K. Acceptable Manufacturers (All listed must be lead free):
1. Apollo
 2. Crane
 3. Dezurik
 4. Jenkins
 5. Keystone
 6. Kitz
 7. Milwaukee Valve
 8. Nibco
 9. Stockham
- L. Check Valves
1. Bronze body, 2 inches and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection (Lead Free).
 2. Iron body, 2-1/2 inches and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug (Lead Free).
 3. Acceptable Manufacturers (All listed must be lead free):
 - a. Apollo
 - b. Keystone
 - c. Kitz
 - d. Milwaukee
 - e. Mission Duocheck
 - f. Nibco
- M. Backflow Preventer (All valves for domestic use must be lead free):
1. BFP-1 (2 inches and smaller) bronze body, reduced pressure zone type with two inline independent check valves with an intermediate relief valve, complete with two full port ball valve shut-offs and ball type test cocks. Bronze strainer on inlet. Provide air gap fitting with full size drain piped to nearest floor drain. Watts 909- QT-S-LF.
 2. BFP-2 (2-1/2 inches and larger) stainless steel or FDA epoxy coated ductile iron reduced pressure zone type with two inline independent check valves with reverse relief valves, two non-rising stem resilient sealed gate valves, cast iron strainer on inlet. Provide air gap fitting piped full size to nearest floor drain.

Apollo RP4ALF-YS or Watts 909-NRS-BB-S-LF.

- N. Provide valves of same manufacturer throughout where possible.
- O. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.
- P. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.
- Q. Provide valve, seat and trim materials suitable for the intended service.
- R. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, globe or ball type.
- S. Float Valve
 - 1. On – Off non-modulating action
 - 2. Fully adjustable high and low level settings
 - 3. Float, float linkage and float rod
 - 4. Complete stainless steel material
 - 5. Level differential adjustment minimum to 18 inches maximum
 - 6. Stilling well
 - 7. Acceptable Manufacturer: CLA-VAL

2.02 PIPE SYSTEMS STRAINERS

- A. Body:
 - 1. Bronze "Y" pattern or basket as shown on the drawings.
 - 2. Line size.
 - 3. Threaded strainer blow down port.
 - 4. ASTM A #126 Class B Cast Iron Body.
- B. Construction:
 - 1. 2 inch size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2 inch size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2 inches.
 - 2. With 0.045 perforations in piping systems 2-1/2 inches and 3 inches.
 - 3. With 0.125 perforations in piping systems 4 inches and larger.
- D. Start-up:
 - 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 - 2. Remove after 30 days.
 - 3. Attach to piping for Owner's review.
- E. Acceptable Manufacturers (All listed must be lead free):
 - 1. Apollo
 - 2. Crane

3. Keckley
4. Kitz
5. Mueller
6. McAlear
7. Muesco
8. Nibco
9. Zurn

2.03 SUCTION DIFFUSER

- A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body to fit both the pump inlet and suction pipe size.
- B. Components:
 1. Inlet straightening vanes.
 2. Removable end cap.
 3. Gauge ports.
 4. Threaded strainer blow down port.
 5. Adjustable support foot.
 6. Removable magnetic insert.
- C. The screen shall be as specified for pipe system strainers.
- D. Provide an additional fine mesh disposable strainer for use during start up operations.
 1. Remove after 30 days operation and all flushing is complete.
 2. Attach to piping for owners review.
- E. Construction:
 1. 2 inch size and smaller with screw connections rated 400 psi WOG. Over 2 inch size with flanged connections, rated 125 psi WOG.
- F. Fabricate screens of Monel or type 304 stainless steel:
 1. With 20 mesh woven wire in piping systems through 2 inches.
 2. With 0.045 perforations in piping systems 2-1/2 inches and 3 inches.
 3. With 0.125 perforations in piping systems 4 inches and larger.

b. VALVE SCHEDULE

- G. Domestic Service
 1. Gas shut-off service: UL approved for natural gas service.
 - a. Nibco Ball Valve, full port through 1 inch: T-585-70-UL
 - b. Nibco Ball Valve conventional port 1-1/4 inch through 3 inch: T-580-70- UL
 - c. Resun 2-1/2 inch and larger: 143 - 1-UL
 - d. DeZurick 2-1/2 inch and larger: Series 425 or 435
 - e. Locking Type: Rockford 3/4 inch and 1 inch PNP-400
Mueller 1-1/4 inch through 4 inch: Lub-O-seal
 - f. Conbraco Ball Valve, full port through 4 inch: 64-100 Series

- h. Milwaukee Full Port ¼ inch-2 inch
- i. Milwaukee Standard Port 2-1/2 inch & 3 inch
- j. Kitz Full Port 2 inch =- #68
- 2. Cold and Hot water service (all listed must be Lead Free):
 - a. Nibco Ball Valve full port through 2 inch: T-585-66-LF
 - b. Nibco Ball Valve 2-1/2 inch and 3 inch conventional port: T-580-66-LF
 - c. Nibco Butterfly Valve 4 inch and larger: LD-2000 EDPM Gaskets
 - d. Watts Ball Valve 4 inch and larger: G-4000-FDA
 - e. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
 - f. Kitz Full Port through 2 inch - #868M Lead Free
 - h. Milwaukee Full Port ¼ inch-2 inch
 - i. Milwaukee Standard Port 2-1/2 inch & 3 inch
 - j. Apollo Ball Valve Full Port through 2-1/2 inch 77CALF
 - k. Apollo Ball Valve Standard Port 3 inch 70LF
 - l. Apollo Butterfly Valve 4 inch and Larger LD141
 - m. Apollo Press Bronze Ball valves – 77 WLF
- 3. Compressed air system
 - a. Nibco Ball Valve full port through 2 inch: T-585-70-66
 - b. Nibco Ball Valve 2-1/2 inch and 3 inch conventional port: T-580-70-66
 - c. Watts Ball Valve 4 inch and larger: G-4000
 - d. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
 - e. Milwaukee Valve Full Port through 2 inch – BA-400S
 - f. Apollo Ball valve full port through 1-1/2 inch 77CA
 - g. Apollo Ball Valve standard port 3 inch 70
 - h. Apollo Press Bronze Ball valves: 77W
- 4. Check Valve (All listed must be Lead Free):
 - a. Nibco Check Valve: T - 413 - Y -LF (Teflon Seats)
 - b. Nibco Check Valve 2-1/2 inch and larger: F - 918 – Y -LF (Buna-N disc.)
 - c. Nibco Check Valve 2-1/2 inch and larger: W - 920 -W-LF (Wafer)
 - d. Kitz Y & Check: A-22T
 - e. Kitz 2-1/2 inch and Larger #778 C.I.
 - f. Kitz Wafer Check 2-1/2 inch and Larger #7032
 - g. Milwaukee Valve – 509T
 - h. Apollo Check Valve: 163TLFApollo Check Valve 2-1/2 inch and larger: 910FLF
 - i. Apollo Press Check Valve: 163TPR-LF
 - j. Apollo Check Valve 2 inch and larger 910WE-LF (Wafer)
- 5. Globe Valve:
 - a. Nibco Globe Valve: T - 235 - Y (Teflon Seats)
 - b. Nibco Globe Valve 2-1/2 inch and larger: F - 718 - B (Bronze Seats)
 - c. Milwaukee Valve 590T
 - d. Apollo Globe Valve – 120T (Teflon Seats)
 - e. Apollo Glove Valve 121T (Bronze Seats)
- 6. Gate Valve
 - a. Nibco Gate Valve through 2 inch: T-133
 - b. Nibco Gate Valve 2-1/2 inch and Larger: F-617
 - c. Milwaukee Valve Through 2 inch 1140
 - d. Milwaukee Valve 2-1/2 inch and Larger – F2885A

- e. Apollo Gate Valve through 2 inch: 106T
- f. Apollo Gate Valve: 2-1/2 and Larger: 611F)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.
- C. Use butterfly valves and ball valves in domestic hot water and domestic cold water systems interchangeable in place of gate and globe valves.
- D. Use butterfly valves and ball valves in circulating water systems, for balancing duty.
- E. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 - 1. 1 inch valve for pipes 6 inch and larger.
 - 2. 3/4 inch valve for pipes smaller than 6 inch.
 - 3. Terminate with pipe plug.
 - 4. Drain valves shall be ball valves.
- F. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on the drawings.
- G. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- H. Provide clearance for installation of insulation and access to valves.
- I. Provide access where valves are not exposed.

3.02 VALVE TAGS

- A. Furnish valves with 1-1/2 inch diameter brass valve tags with stamped, black or red-filled numbers. Service designations shall be 1/4 inch letters, and valve numbers shall be 2 inch letters. Engineer shall approve Service designations. Secure tags to valves by use of brass "S" hooks or brass chain. Secure chain to valve by use of copper or Monel meter seals. Valve tags are not required if the valve is located within 3 feet of the equipment being served and the service is obvious.
- B. Mount charts and drawings listing functions of each valve and its location in a metal and glass frame. Place charts and drawings as directed; in addition, on the record drawings mark the symbols and furnish a valve schedule properly identifying the valve number, service, exact location, the material being piped, and the room number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The Owner shall approve the size of

drafting paper. Provide a copy of the valve chart in the Operating and Maintenance Manuals.

3.03 PIPE SYSTEMS STRAINERS

- A. Provide strainers in supply piping to circulating pumps, thermostatic mixing valves, before solenoid valves and trap primer valves.

END OF SECTION 22 05 23

SECTION 22 05 33
PIPE HEAT TRACING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install a complete industrial, constant wattage, UL listed system of electric pipe heat tracing and controls on all make-up water piping outdoors above grade to prevent freezing. The heat tracing system shall conform to ANSI/IEEE Standard 515-1989.
- B. Protect the pipe, valves, fittings, meters and appurtenances. Apply sufficient cable and overheat thermostat to protect the entire system.

1.02 SUBMITTALS

- A. Submit shop drawings and product data as specified in Section 22 05 12.
- B. Submit detailed calculations for length of heat tracing cable per foot of pipe, based on actual length of piping installed.
- C. Submit manufacturer's certified capacity charts with selections plotted thereon.
- D. Submit manufacturer's installation instructions.
- E. Submit full load ampere requirement and voltage for branch circuit.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Raychem Corporation
- B. Thermon Manufacturing Company

2.02 COMPONENTS

- A. Self-regulating heater.
 - 1. The self-regulating heater shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed itself without overheating and to be cut in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
 - 2. In order to provide energy conservation, and to prevent overheating, the heater shall have a self-regulating factor of at least 90%.
 - 3. The heater shall operate on a line voltage of 120 VAC without the use of transformers.

4. The heater shall be sized according to the following. The required heater output rating is in watts per foot at 50°F (heater selection based on 1-1/2 inch fiberglass insulation on metal piping).
5. The heater shall be XL-Trace as manufactured by Raychem Corporation or XL-Econotrace as manufactured by Thermon Manufacturing Company.
6. Power connection, end seal, splice and tee kits components shall be applied in the field.
7. The system shall be controlled by an ambient sensing thermostat set at 40°F either directly or through an appropriate contactor.
8. Provide an end-of-circuit voltage indicating light

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install and start up the pipe heat tracing system in accordance with the manufacturer's Installation, Start-up and Service Instructions.
- B. Install the pipe heat tracing cable under the pipe insulation.
- C. Apply "Electrically Traced" signs to the outside of the thermal insulation.
- D. Ground fault protection of the equipment shall be provided per the 1996 National Electrical Code, Article 427-22.
- E. Provide a cast aluminum weatherproof NEMA-4 rated junction box for installation of the cable, with pilot light to indicate operation of the cable.
- F. Use only electrical components as recommended by the manufacturer.

3.02 ELECTRICAL WORK

- A. Furnish and install the wire, conduit and raceway systems required for the automatic operation of the pipe heat tracing system. Conform to the National Electrical Code.
- B. The specified wiring work includes:
 1. Wiring of control instruments between thermostat and junction boxes
 2. Installation of thermostat and junction boxes
 3. Wiring from the heat tracing cable to the junction boxes
- C. Related branch circuit power wiring from the junction box to ground fault type circuit is specified to be provided in Division 26.
- D. Provide devices and appurtenances as specified in Division 26.
- E. Identify each circuit at each terminal with a separate tag.
- F. Color code wires in accordance with IPCEA Standards.

- G. Make all joints and connections with approved mechanical connectors.

3.03 TESTING OF THE PIPE HEAT TRACING SYSTEM

- A. Test the pipe heat tracing system:
 - 1. Simulate freezing outside air conditions
 - 2. Measure the amperage draw of the heat tracing system
 - 3. Compare to the manufacturer's capacity rating of the actual system
 - 4. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be between 20 to 1000 megohms regardless of the length.
- B. Submit records of test for approval prior to substantial completion; insert in the Owner's Manual.

END OF SECTION 22 05 33

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including domestic hot and cold water, roof and overflow drain sump bodies and rain leaders, horizontal sanitary drain piping which receives condensate, make-up water and pool heating water.
- B. Furnish and install plenum wrap insulation over PVC vent piping.

1.02 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.03 APPROVALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval

before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
 - 1. Johns-Manville Micro-Lok AP-T
 - 2. Owens-Corning ASJ/SSL
 - 3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
 - 1. Pittsburg Corning
 - 2. Cell-U-Foam
- C. Aluminum Jacketing:
 - 1. Childers
 - 2. Pabco
 - 3. RPR
- D. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Vimasco
- E. Mastics and Adhesives
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
 - 4. Armstrong 520 Adhesive
- F. Elastomeric Insulation
 - 1. Armacell
- G. Weather Resistant Coating
 - 1. WB Armaflex Finish
- H. Glass fiber blanket insulation
 - 1. Manville R-series Microlite FSKL
 - 2. Owens-Corning eD75 or ED100 RKF
 - 3. Knauf 0.75 PCF FSK
- I. Fire Barrier Plenum Wrap Insulation
 - 1. Totally encapsulated with foil facing
 - 2. Single layer fire protection

3. Plenum Protection System UL910
4. Acceptable Manufacturers:
 - a. FyreWrap 0.5 Plenum Insulation
 - b. 3M Fire Barrier Plenum Wrap 5A

2.02 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
 1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.03 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than ¾" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test. Minimum ¾" thick.
 1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.04 CELLULAR GLASS INSULATION

- A. ASTM C552:
 1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
 2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.05 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½" aluminum bands (2) per shield.
 1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 2. Minimum thickness of foam glass insulation shall not be less than 1" thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.06 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 adhesive.
- B. Vapor Barrier Finish:
 - 1. Indoors: Provide as insulation coating Childers CP-35, white.
 - 2. Outdoors: Provide as insulation coating Childers Encacel X.
 - 3. Underground: Provide Childers CP-22/24 for fittings and areas. Pittwrap cannot be used.
- C. Sealant. Provide Childers CP-76 vapor barrier sealant.
- D. Lagging Adhesive. Provide Childers CP-50.
- E. Other products of equal quality will be acceptable only upon approval.

2.07 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier. Childers Lock-On or approved equal.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.
- C. Straps and Seals. Provide ½" x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.08 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

2.09 FIRE BARRIER PLENUM WRAP

- A. High temperature insulation blanket specifically designed to provide a single layer, flexible enclosure around combustible items located within fire rated return air plenums.

PART 3 - EXECUTION

3.01 INTERIOR PIPING

- A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-35 vapor barrier coating for chilled water piping applications.
- B. Install hanger with protective shield, on the outside of all insulation.
- C. Where domestic water pipes (1/2" & ¾" pipe sizes) are installed on trapeze type hangers,

provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.

- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.
- E. Seal ends of pipe for drinking chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
- F. Apply a smooth flood coat of white lagging Foster 8142W over all exposed insulation.
- G. Piping to be insulated as specified above:
 - 1. All hot and cold water.
 - 2. Make-up water
 - 3. Horizontal sanitary drain piping that receives condensate
 - 4. Exposed to view storm drainage system including roof and overflow drain bodies, vertical piping from drain body and all horizontal rain leaders to first elbow turning down

3.02 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using CP-82 adhesive. Secure fitting insulation covers and segments in place with 1/2" wide glass filament tape.
- D. Apply a tack coat of fitting mastic over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
- F. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- H. Finish with aluminum jacketing as specified.

3.03 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the

adjoining pipe. Fittings and fabricated segments shall be securely held in place.

1. Apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
2. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
3. Overlap mastic and fiberglass cloth by 2" on adjoining sections of pipe insulation.
4. Apply a second coat of mastic over the fiberglass cloth to present a smooth surface.
5. Apply mastic to a wet film thickness of 3/64".
6. Fabric shall not be visible after completion.
7. Vapor seal flanges, valves and fittings with Childers CP-35.

B. PVC fitting covers are not acceptable.

3.04 ALUMINUM JACKETING (Insulated Piping Outdoors Above Grade)

- A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal.
- C. Install straps on 9" centers and at each circumferential lap joint.
- D. Cover and seal all exposed surfaces.
- E. The use of screws and rivets is not approved.
- F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.05 CONCEALED STORM DRAIN PIPING

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing. Install insulation of clean, dry piping.
- B. Insulation shall be wrapped tightly on the piping with all circumferential joints and longitudinal joints overlapped a minimum of 2" with facing to the outside to obtain specified R-value using a maximum of 25% compression.
- C. Provide vapor retarder at penetrations, joints, seams and damage to the facing with staples and FSK foil tape. The facing shall be taped with a minimum 3" wide strip of reinforced foil tape. Pressure-sensitive tape shall be a minimum 3" (76mm) wide and shall be applied with moving pressure using an appropriate sealing tool. Staples shall be outward cinch and placed 6" (152mm) on center.
- D. Mechanical / Electrical rooms and above ceilings are considered concealed spaces.

3.06 MISCELLANEOUS

- A. Install materials after piping has been tested and approved.
- B. Apply insulation on clean, dry surfaces only.
- C. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.
- D. Install plenum wrap material with bands as specified at PVC vent piping as required.

3.07 INSULATION THICKNESS

<u>INSULATED UNIT</u>	<u>THICKNESS</u> <u>(Inches)</u>
Exposed Roof Drain Bodies and Horizontal Roof Drain Leaders	1
Exposed Roof Overflow Drain Bodies and Horizontal Drain Leaders	1
Domestic Cold Water/Make-Up Water Piping/Drinking Chilled Water	1
Horizontal Sanitary Drain Piping Which Receives Condensate	1
Domestic Hot Water Piping, 1-1/2" Pipe and Smaller	1
Domestic Hot Water Piping, 2" Pipe and Larger	1-1/2
PVC Vent Piping	1/2

END OF SECTION 22 07 19

SECTION 22 11 16
DOMESTIC WATER PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install domestic hot and cold water piping.

1.02 RELATED WORK

- A. Division 22 Plumbing
1. Valves, Strainers and Vents
 2. Pipe and Pipe Fittings - General
 3. Plumbing Piping Insulation
 4. Plumbing Fixtures and Fixture Carriers

PART 2 - PRODUCTS

2.01 PIPING AND FITTINGS

- A. Below Slab on Grade Piping for Water Entries:
1. 2-inch and smaller, provide ASTM B88 Type L (heavy wall) annealed tempered (soft) seamless copper water tube. No joints below slab entries.
 2. 2-1/2-inch and 3-inch, provide ASTM B88 Type L (heavy wall) annealed tempered (soft) seamless copper water tube, 20 ft. straight lengths. One joint allowed below slab entry using wrought copper, solder-joint pressure fittings: ASME B16.22 with an approved brazing filler metal or pipe can be shop bent for no joint installation by using a "bending" temper tubing.
 3. 4-inch and larger, provide ductile iron pipe with mechanical joints, ANSI A21.6.
 4. 4 inch and larger, provide one-piece stainless steel IBR (in building riser), Watts or Ames.
 5. 2 inch to 3 inch, provide one piece stainless steel IBR2 (in building riser). Watts or Ames.
- C. Below Slab on Grade Piping. Furnish ASTM B 88 and ANSI/NSF Standard 61 annealed tempered (soft), Type K copper water tube. Run continuous with no joints under the floor slab. Provide copper pipe corrosion protection as specified in this Section.
- D. Above Slab Piping. Provide seamless ASTM B 88 and ANSI/NSF Standard 61 drawn tempered (hard) Type L copper water tube with wrought copper or bronze fittings with solder-joints, ANSI B16.22. Solder material shall be 95-5 (lead free) (Tin-Antimony-Grade 95TA) ASTM B 32.
- E. Unions. Provide 150 lb. standard unions with ground joint and bronze seat. Flange joints larger than 2 inches. Provide dielectric isolating unions at junctions or connection between metallic piping of dissimilar metal. Provide pipe threads with standard taper pipe threads ANSI B2.1.
- F. Alternate Method of Joining Copper Pipe and Tubing: Press Fittings: Copper press fitting shall conform to the material and sizing requirements of ASME B16.51. O-rings for copper

press fittings shall be EPDM. VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

G.

2.02 WATER HAMMER ARRESTORS

- A. Provide piston type hydraulic engineered/manufactured water hammer arrestors in cold and hot water supply lines in chases or walls to each fixture branch or battery of fixtures serving quick closing valves of electrical, pneumatic, spring loaded type, or quick hand closure valves on fixture trim. Provide water hammer arrestors at the end of the branch line between the last two fixtures served. Provide Precision Plumbing Products, Inc., or equal. Size units according to water hammer arrestor's Standard PDI WH-201; refer to schedule on drawings.
- B. Install all water hammer arrestors so as to attain 100% effectiveness according to Plumbing and Drainage Institute PDI-WH201 Table 5, 6 and 6-A for water hammer arrestors.
- C. All water hammer arrestors shall be installed in a vertical position.
- D. All water hammer arrestors shall be accessible and shall have access panels where required. Arrestors located above ceilings in fixture drops will not be acceptable. Refer to sizing and placement data as indicated in PDI Standard PDI-WH-201.

PART 3 - EXECUTION

3.02 STERILIZATION

- A. Sterilize the water system with solution containing not less than 50PPM available chlorine. Allow chlorinating solution to remain in system for period of 8 hours (minimum). Have valves and faucets opened and closed several times during the period. After sterilization, flush the solution from the system with clean water until residual chlorine content is less than 0.2 parts per million.

3.03 UNDERGROUND WATER PIPING SYSTEM PROCEDURES

- A. Lay sewer and water lines in separate trenches, separated by 10 foot of undisturbed or compacted soil.

3.04 TESTING

- A. Test under a cold water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Test the domestic water piping system at 150psig hydrostatic pressure, maintained for 6 hours.
- C. Use only potable water for the test.

- D. Perform the test before fixtures, faucets, trim or final connections are made to equipment.
- E. If the system is tested in sections, the entire domestic water piping system shall be submitted to a final test, employing the specified procedure.
- F. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- G. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- H. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.05 COPPER PIPE CORROSION PROTECTION

- A. Corrosion protect copper tube piping systems:
 - 1. In the building slab.
 - 2. Beneath the building slab.
 - 3. Buried.
 - 4. Route plasti-sleeve 0.006 thick material entire length of below slab on grade copper tubing.
- B. Cover copper tubing piping system with:
 - 1. "Tapecoat" TC Primer.
 - 2. "Tapecoat" CT cold applied coating tape.
- C. Install coating system as specified by the manufacturer.
- D. Extend the corrosion protection 2 inches above concrete slab on grade.

3.06 TEST OF PIPE CORROSION PROTECTION SYSTEM

- A. Test the pipe corrosion protection coating with an approved high voltage tester adjusted to provide sufficient voltage to produce a spark through a pinhole in the coating (at least 15 kv AC).
- B. Make repairs to small holes in accordance with the manufacturer's instructions.
- C. Retest the repairs using procedures listed above.
- D. Furnish certificate of compliance with field testing in Owner's manual.

END OF SECTION 22 11 16

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. General characteristics for pumps specified in Division 22 - Plumbing.

1.02 RELATED WORK

Requirements for pumps are specified in other sections of Division 22 - Plumbing, including the following:

- A. Division 22 Plumbing - Electrical Provisions of Plumbing Work.

1.03 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.

1.04 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.
- B. Submit copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the

selection point.

1.05 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.03 DOMESTIC HOT WATER CIRCULATING PUMPS (Variable Speed) FRACTIONAL HORSEPOWER

- A. Pump Construction:
 - 1. Variable speed with automated ability to adjust and maintain optimum operating conditions Stainless steel housing
 - 2. Check Valve
 - 3. Flange or union connections
 - 4. Built in timer
 - 5. Built in temperature sensor
 - 6. Build in differential pressure sensor
 - 7. Programmable
- B. Acceptable manufacturers:
 - 1. Grundfos
 - 2. Armstrong
 - 3. Wilo

2.04 VERTICAL PEDESTAL TYPE PUMPS (Sump Pump & Sewage Pumps)

- A. Pump construction:
 - 1. Cast iron designed for 150-psi working pressure
 - 2. Bronze fitted
 - 3. Cast iron pedestal base and suction elbow fitting
- B. Bearings:
 - 1. Conform to Anti-Friction Bearing Manufacturers Association (AFBMA) Standards
 - 2. Ball or roller bearing pillow block type
 - 3. Self-aligning
 - 4. AFBMA L10 rating of 25,000 hours
- C. Arrange pump for back pull out.
- D. Provide each pump with a mechanical seal.
 - 1. Use seal materials suitable for the pumped liquid.
 - 2. Renewable bronze shaft sleeve.
- E. Paint entire unit with two coats of machinery enamel after completion of installation.

- F. Pump motor:
 - 1. NEMA Standard
 - 2. Open drip-proof
 - 3. TEFC where located outdoors
 - 4. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve.

- G. Data plates:
 - 1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
 - 2. Locate the nameplate for easy visibility.
 - 3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)

- H. The type of pump and gpm required are scheduled on the drawings.
 - 1. The head capacities and horsepower are for bidding purposes only.
 - 2. Make pump selection based on actual system calculations.

- I. Acceptable Manufacturers:
 - 1. Pacific
 - 2. Bell & Gossett
 - 3. Amtrol/Thrush
 - 4. Armstrong
 - 5. Aurora

2.05 SUBMERSIBLE SUMP PUMPS AND SEWAGE EJECTORS

- A. Pump Construction:
 - 1. Hermetically sealed motor
 - 2. Positive action air operated diaphragm switch
 - a. High water alarm contact
 - 3. Housing and base cast iron construction

- B. Provide an alarm terminal cabinet.
 - 1. In the event of a high water alarm, energize a pulsing 2" diameter red signal light

with graphic "sump pump high water alarm".

- C. Test the sump pump package by operation of the completed system through four cycles of operation.
 - 1. Fill the sump to operational levels
 - 2. Visually check level controls
 - 3. Pump operation
 - 4. Verify absence of piping leaks, sump leaks, excessive noise, and excessive vibration
 - 5. Verify alarms
 - 6. Verify pump capacity
- D. Sump pump package capacity shall be as scheduled.
- E. Acceptable Manufacturers:
 - 1. Hydromatic
 - 2. Little Giant Pump Co.
 - 3. Weil
 - 4. Goulds
 - 5. Grundfos
 - 6. Crane (Barnes) Air Pumps
 - 7. Ebara
 - 8. Zoeller Pumps

2.06 FLOW INDICATOR

- A. Flow Indicator
 - 1. Bronze Construction
 - 2. Rotating wheel
 - 3. Line Size
 - 4. Double Window
 - 5. Ernst Flow Industries Model EFI E-57-3

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 - 1. Provide access space around pumps for service.
 - 2. Lubricate pumps prior to start-up.
 - 3. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser

on discharge side.

- D. Ensure pumps:
 - 1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 - 2. Are non-overloading in parallel and individual operation.
 - 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.02 ALIGNMENT FOR BASE MOUNTED PUMPS

- A. Set the pump on a concrete inertia base or concrete housekeeping pad as specified. Anchor, level and grout.
- B. Align the pump and driver in accordance with Hydraulic Institute Standards for centrifugal, rotary and reciprocating pumps.
- C. Realign the pump and driver after initial leveling of pump base before placing the grout and again after the grout has set and the foundation bolts are tightened. Recheck the alignment after the piping has been connected.

3.03 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
 - 1. Technicians, as required, shall be trained and experienced in the work they perform (Contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
 - 1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 - 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 - 3. Submit readings for approval.
 - 4. Include the approved readings in the Owner's Maintenance Manual.

3.04 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
 - 1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 - 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 - 1. Modify the pump nameplate to reflect the correct head and flow data and the

impeller diameter.

3.05 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 - 1. A mechanical seal for each pump
 - 2. A set of bearings for each pump

END OF SECTION 22 11 23

SECTION 22 11 25
DOMESTIC WATER BOOSTER PUMP
(In-Line Vertical Multi-Stage w/VFD)

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. Variable Speed Packaged Pumping System with VFDs.

1.02 REFERENCE STANDARDS

- A. The work in this section is subject to the requirements of applicable portions of the following standards:
 - 1. ANSI – American National Standards institute
 - 2. ASTM – American Society for Testing and Materials
 - 3. IEEE – Institute of Electrical and Electronics Engineers
 - 4. NEMA – National Electrical Manufacturers Association
 - 5. NEC – National Electrical Code
 - 6. ISO – International Standards Organization
 - 7. UL – Underwriters Laboratories

1.03 SUBMITTALS

- A. Submit shop drawing and product as specified.
- B. Submit manufacturer's certified capacity data.
- C. Submit manufacturer's installation, start-up and service instructions.
 - 1. Electrical Interlocks
- D. Submit wiring diagram.

1.04 SHIPPING, HANDLING AND STORAGE

- A. Deliver, store, protect, and handle in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals. All equipment and accessories shall be suitably boxed, crated, covered and protected internally and externally to prevent shipping damage and damage from the weather.
- B. Inspect and report concealed damage to carrier within specified time.
- C. Store in a clean, dry space. Maintain factory protection or cover to keep out dirt, water, construction debris, and traffic (heat enclosures to prevent condensation).

PART 2 – PRODUCTS

2.01 VARIABLE SPEED PACKAGED PUMPING SYSTEM WITH INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

- A. Furnish and install a prefabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure.
- B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller shall be designed and built by the same manufacturer.
- C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.

2.02 PUMPS

- A. All pumps shall be ANSI/NSF 61 approved for drinking water.
- B. The pumps shall be of the in-line vertical multi-stage design.
- C. The head capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

- D. Small vertical in-line multi-stage pumps (nominal flow from 3 to 125 gallons per minute) shall have the following features:

1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
2. The suction / discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.
3. Pump Construction:

Suction/discharge base, pump head, motor stool	Cast Iron (Class 30)
Impellers, diffuser chambers, outer sleeve	304 Stainless Steel
Shaft	316 or 431 Stainless Steel
Impeller wear rings	304 Stainless Steel
Shaft journals and chamber bearings	Silicon Carbide
O-rings	EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18)

Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M resulting in all wetted parts of stainless steel.

4. The shaft seal shall be a balanced o-ring cartridge type with the following features:

Collar, Drivers, Spring	316 Stainless steel
Shaft Sleeve, Gland Plate	316 Stainless Steel
Stationary Ring	Silicon Carbide
Rotating Ring	Silicon Carbide
O-Rings	EPDM

The Silicon Carbide shall be imbedded with graphite.

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with

motors equal to or larger than 15 HP (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

- E. Large in-line vertical multi-stage pumps (Nominal flows from 130 to 500 gallons per minute) shall have the following features:
1. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.
 2. The suction / discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.
 3. Pump Construction:

Suction/discharge base, pump head	Ductile Iron (ASTM 65-45-12)
Shaft couplings, flange rings	Ductile Iron (ASTM 65-45-12)
Shaft	431 Stainless Steel
Motor Stool	Cast Iron (ASTM Class 30)
Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
Impeller wear rings	304 Stainless Steel
Intermediate Bearing Journals	Tungsten Carbide
Intermediate Chamber Bearings	Leadless Tin Bronze
Chamber Bushings	Graphite Filled PTFE
O-rings	EPDM

4. The shaft seal shall be a single balanced metal bellows cartridge with the following construction:

Bellows	904L Stainless Steel
Shaft Sleeve, Gland Plate, Drive Collar	316 Stainless Steel
Stationary Ring	Carbon
Rotating Ring	Tungsten Carbide
O-Rings	EPDM

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 HP (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.03 INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

- A. Each motor shall be of the integrated Variable Frequency Drive design consisting of a motor and a variable frequency drive (VFD) built and tested as one unit by the same manufacturer.
- B. The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology.
- C. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain

desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

- D. The VFD shall utilize an energy optimization algorithm to minimize energy consumption. The output voltage

PART 3 - EXECUTION

3.01 FACTORY FABRICATION

- A. All of the above equipment will be mounted on an open structural steel I-beam skid. All piping, pressure sensing lines, pump by-pass, shut-off valves, stuffing box and casing relief valve drains will be firmly anchored to the steel base by means of structural steel supports. All electrical wiring between controllers and drivers will be completed and tested at the factory. The entire package will require one power connection by the electrical contractor.

3.02 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions.

3.03 FIELD ACCEPTANCE AND START-UP SERVICE

- A. The service of a factory-trained representative shall be made available on the job site to check installation, field acceptance testing, start-up and instruct operating personnel.
- B. In order to ensure the pump unit is properly coordinated and will function in accordance with the intent of these specifications, all the equipment required to comprise the pump unit will be supplied by the pump manufacturer in whom shall be vested unit responsibility for the proper function of the complete pump unit including the pump, motor or engine, base plate, control equipment and other required accessories.
- C. To verify compliance with this requirement, the pump manufacturer will be required to submit a notarized Certificate of Compliance certifying that all components of the pump unit were in fact supplied by the pump manufacturer and acknowledging its responsibility for the proper function of the unit.

3.04 GUARANTEE

- A. The pumping system shall be guaranteed in writing, by the manufacturer for a period of one year from date of shipment against defect in design, material or construction.

END OF SECTION 22 11 25

SECTION 22 13 16
SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install piping in buildings and underground laterals to 5 foot outside of building.
- B. Cellular Core PVC pipe is not permitted.

1.02 RELATED WORK

- A. Site Work:
 - 1. Sanitary Sewers
 - 2. Excavation, Trenching and Backfilling for Utilities
- B. Division 22 Plumbing:
 - 1. Pipe and Pipe Fittings
 - 2. Plumbing Fixtures and Fixture Carriers
 - 3. Drains, Cleanouts and Hydrants
 - 4. Earthwork
 - 5. Plumbing Piping Insulation

1.03 REFERENCES

- A. CISPI - Cast Iron Soil Pipe Institute
- B. ASTM - American Society for Testing and Materials

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All No-Hub clamps must have 4 bands minimum. Sizes 5" through 10" shall have six bands minimum.
 - 1. No-Hub Clamps – Sanitary Waste:
 - a. Husky SD 4000
 - 2. No-Hub Clamps - Vents
 - a. Husky SD – 2000
 - b. Mission Rubber Co., LLC Heavy Weight Couplings
 - 3. Clamp-All Hi-TorQ 80 or approved equal
- B. Provide Fernco "Pro-flex" shielded couplings Series 3000 with one piece neoprene gasket for all cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 1-1/2" through 8" Series 3000.
- C. Cast Iron Soil Pipe and Fittings:
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.

3. Tyler Pipe / Soil Division

2.02 DRAIN PIPE AND FITTINGS

- A. Above Slab Pipe:
 - 1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM A888.
 - 2. Pipe shall conform to ASTM A74.
 - 3. No-hub couplings shall meet or exceed the latest specification standard CISPI 310 or ASTM C-1540 and conform to FM 1640. CISPI 310 Couplings shall be listed by NSF International.
 - 4. Rubber Gaskets for cast iron soil pipe and fittings shall conform to ASTM C564
 - 5. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute
- B. Below Slab on Grade Pipe for Grease Waste as indicated on Drawings for Hot Grease Waste Discharge:
 - 1. Service weight/cast iron hub and spigot pipe and fittings
 - 2. Compression type, with neoprene gaskets shall conform to ASTM C-564.
 - 3. Pipe shall conform to requirements of ASTM A74.
 - 4. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute
- C. Below Slab on Grade Piping:
 - 1. Schedule 40 PVC plastic pipe and DWV fittings.
 - 2. Solvent welded DWV joints shall conform to IAPMO Installation Standard IS-9.
 - 3. Pipe and fittings shall conform to ASTM D 1784, ASTM D 1785, ASTM D 2665, ASTM D 3311 and NPS Standard 14 & 61.

2.03 VENT PIPE AND FITTINGS

- A. Above Slab Pipe:
 - 1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM A888.
 - 2. Pipe shall conform to ASTM A74.
 - 3. No-hub couplings shall conform to CISPI 310 and shall be listed by NSF International
 - 4. Rubber gaskets for cast iron soil pipe and fittings shall conform to ASTM C564
- B. Below Slab on Grade Piping:
 - 1. Provide Schedule 40 PVC with DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D1784-82.
- C. Above Slab Pipe.
 - 1. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.

PART 3 - EXECUTION

3.01 INSTALLATION

SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING AND APPURTENANCES

- A. All above and below slab soil, waste, sanitary drain and vent piping installation methods shall be in accordance with Cast Iron Soil Pipe Institute Standards.
- B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers are to be placed within 18" of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15'-0".
- C. All above and below slab PVC sanitary waste and vent piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer's recommendations and applicable standards.
- D. Tracer wires shall be installed on all underground PVC sanitary sewer lines installed outside the building slab.
- E. All PVC underground shall be installed in accordance with ASTM D2321.

3.02 GRADE

- A. Give horizontal pipe grade of 1/4-inch per foot where possible, but not less than 1/8 inch per foot unless otherwise shown.

3.03 DRAIN PIPE AND FITTINGS

- A. Offsets and Fittings.
 - 1. Use reduction fittings to connect two pipes of different diameter.
 - 2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth-, eighth-, and sixteenth-bends. Sanitary tees can be used on vertical stacks. Use long sweeps at the base of risers.
 - 3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a deep seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
- B. Hub Drains. Install hub drains where indicated, with the top of the hub 1/2 above the finished floor, unless otherwise indicated on the drawings.
- C. Cleanouts. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter.
 - 1. Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Where cleanouts occur in floor slabs, set flush. Reference drawing schedule.
 - 2. Provide cleanouts where soil lines change direction, every 50 foot on long runs, or as shown on the drawings, at the end of each horizontal waste line, and at the base of each riser (and at each increase in pipe size).
 - 3. Cleanouts shall occur at the end of each battery of water closets, urinals, lavatories, sinks, and single water closets. Cleanouts shall be installed so as to access the main sanitary or soil line. Extend and offset above flood rim of water

- closet.
- 4. Double sanitary tees and double quarter bends do not allow for easy access to main lines, therefore these types of fittings are not allowed.

- D. Floor Drains. Locate floor drains 1/2-inch below finish floor elevation unless otherwise shown.

3.04 VENT PIPING

- A. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6 inches above the roof.
- B. Flash the roof penetration with 6 lb. lead flashing approximately 24 inches square. Flange the flashing to the lead sleeve. Extend the flashing up and around the vent pipe. Turn the flashing down inside the pipe at least 2 inches to make a watertight joint. Flashing shall comply with the roofing manufacturer's requirements. Reference the Architectural Drawings for exact requirements.
- C. Locate vent piping through roof a minimum horizontal distance of not less than 20 feet from any air intake opening or supply fan.

3.05 TESTING

- A. Below Slab on Grade and All Floors in Multi-Story Buildings:
 - 1. Test pipe below slab on grade before backfilling and connecting to city sewers.
 - 2. Maintain not less than 10 foot of hydrostatic head for 1 hour without a leak.
 - 3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
 - 4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
 - 5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
 - 6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.
 - 7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
 - 8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.
- B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:
 - 1. Plugging outlets.
 - 2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
 - 3. Test for 6 hours without any drop in the water level.

3.06 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out and flushed out after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.
- B. All sanitary soil and waste lines below building 3" and larger shall be internally videotaped at time of substantial completion. All videotaping shall include on-screen date and time, and include audio narration. All videotaping shall be provided by experienced individual in videotaping piping systems. An Owner's Representative shall be present during video-taping. Three copies of the videotape shall be delivered to the Owner for future records.
- C. This work shall be done in the presence of the Owner's Representative, as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing the proper rotary head to clear sewer. Pipe sizes 8 inches and larger shall be hydro-flushed.

3.07 SMOKE TESTING – LIQUID SMOKE SYSTEM

- A. Interior Plumbing Piping:
 - 1. Contractor shall perform smoke testing for finding leaks in all interior of building sanitary sewer piping and sanitary vent piping above and below building slab prior to cover up.
 - 2. Contractor must use a laboratory tested safe liquid smoke with a patented liquid smoke generating system. The liquid smoke must be contained in a pressure tank with inline filter and quick disconnect.
 - 3. Smoke generating system must generate up to 3 hours or more of continuous and constant smoke. Generating system must have a metering valve to precisely control smoke flow and density. Smoke generating system must have a 4" x 6" industrial flexible mining duct for connection to vent stack or cleanout.
 - 4. Smoke generating system must be power full enough to push smoke through the smallest leaks.
 - 5. The liquid smoke must not leave any stains or odors.
 - 6. The liquid smoke shall not contain Zinc Chloride, a listed toxic compound in OSHA 1915,1000 – Air contaminants.
 - 7. Smoke generating system must have a means to atomize the liquid smoke and have an enclosed fan system capable of up to 700 cfm with adjustable inlet damper control to adjust cfm as necessary for the size of system.
 - 8. Provide Hurco "Power smoker " with Hurco "LiquiSmoke" system or approved equal.
 - 9. All plumbing fixtures must be installed including floor drains with wetted trap seals.
 - 10. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and

emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.

11. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
12. Typical findings from indoor smoke testing may include:
 - a. Dry traps in floor drains
 - b. Improperly capped sewer lines or vents
 - c. Broken sewer lines or vents
 - d. Cross connected sewer vents and drains
 - e. The drawing of air emanating from sewer vents into intakes of air exchange systems
 - f. Poorly glued pipe joints
 - g. Loose no-hub couplings
13. An Owner's Representative shall be present during smoke testing.

END OF SECTION 22 13 16

SECTION 22 14 13
ROOF DRAINAGE PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install roof drains, drain pipes and accessories.

1.02 RELATED WORK

- A. Division 22 Plumbing
 - 1. Pipe and Pipe Fittings - General; for general piping requirements.
 - 2. Drains and Cleanouts.
 - 3. Plumbing Piping Insulation.
 - 4. Earthwork

1.03 REFERENCES

- A. CISPI – Cast Iron Soil Pipe Institute
- B. ASTM – American Society for Testing and Materials

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cast Iron Soil Pipe and Fittings
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe / Soil Division

2.02 STORM PIPE AND FITTINGS

- A. Above Ground Piping. Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82.
- B. Below Slab on Grade: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82.
- C. Provide Fernco “Pro-Flex” shielded couplings, Series 3000 with one-piece neoprene gasket for cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 2” through 8” use Series 3000.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All above and below slab storm piping installation methods shall be in accordance with the Cast Iron Soil Pipe Institute Standards.

- B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers to be placed within 18" of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15'-0".
- C. All above and below slab PVC storm piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer's recommendations and applicable standards, and in accordance with ASTM D2321.

3.02 GRADE

- A. Give horizontal lines minimum grade of 1/8 inch per foot.

3.03 TESTING

- A. Below Floors.
 - 1. Test pipe below floors before backfilling and connecting to sewers.
 - 2. Maintain not less than 10 foot of hydrostatic head for 1 hour without a leak.
- B. System Test. After all the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system:
 - 1. Plugging outlets.
 - 2. Fill vertical sections with water. Provide wyes as required to facilitate plugging.
 - 3. Test for 6 hours without any drop in the water level.

3.04 RODDING SEWERS

- A. All storm sewer lines, both in the building and out, shall be rodded out and flushed out after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.
- B. All storm lines below building 3" and larger shall be internally video-taped at time of substantial completion. An Owner's Representative shall be present during video-taping. Three copies of the video-tape shall be delivered to the Owner for future records.
- C. This work shall be done in the presence of the Owner's Representative, as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned for pipe sizes up to 6 inches. Pipe sizes 8 inches and larger shall be hydro-flushed.

END OF SECTION 22 14 13

SECTION 22 20 00
PLUMBING PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 22 - Plumbing.

1.02 RELATED WORK

- A. Division 22 Plumbing
 - 1. Earthwork
 - 2. Valves, Strainers and Vents
 - 3. Insulation
 - 4. Other Piping Sections

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.02 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on underground water entry piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.
 - 1. Prior to installation of bolts, center and align flanged joints to prevent mechanical

- pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
 3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. No Hub. Hubless joints shall be made with wide body, neoprene sealing sleeve with stainless steel sleeve, coupling joints conforming to ASTM C 1277.
1. 4" pipe size and smaller coupling housing minimum of 3" width; 24 gauge Series 300 stainless steel with hi-torque clamps; neoprene coupling gasket.
 2. 6" through 10" pipe size coupling housing minimum of 4" width.
 3. Tighten clamps to within manufacturer's tolerances using preset torque wrench.
- G. Mechanical Joints. Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
 2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
 3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
 4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.
- H. Compression Joints for Cast Iron Water Pipe. Use Beltite, Tyton or Grip-Tite compression joints. Install in accordance with the manufacturer's recommendations for compression joints. Provide adequate concrete thrust blocks at changes of direction, as recommended by the manufacturer.
- I. Compression Gasket System. Bell and spigot cast iron pipe 4" and smaller, use flax-base lubricant, Tyler Ty-Seal Lubricant or Charlotte Regular Lubricant. 6" and larger use a neoprene base lubricant, Charlotte Adhesive Lubricant.
- J. Ring-Tite Joints: Furnish joints for installation according to manufacturer's recommendations. Provide adequate concrete thrust blocks at changes in direction, as recommended by manufacturer.
- K. Ball Joints. Where shown, provide flexible ball joints, made of carbon steel. Ball joints

must have 15° of angular flexibility. Use welded or flanged ends, as required. Furnish with 11N gaskets.

- L. Mechanically Formed Tee Fitting. Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height not less than three (3) times the thickness of the branch wall. The branch tube shall be notched to conform with the inner curve of the run tube and shall have two (2) dimple / depth stops to insure that penetration of the branch tube into the collar is of sufficient depth for brazing and that the branch tube does not obstruct the flow in the main line tube. Dimple depth stops shall be in line with the run tube. The second dimple shall be one quarter (1/4) inch above the first and shall serve as a visual point of observation. All joints shall be brazed with silver brazing alloy or Sil-Fos. Soft soldered joints shall not be allowed.
- M. Press fittings for copper pipe 1/2" to 4": Copper press fittings shall conform to the material and sizing requirements of ASTM B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Pro-Press System manufactured by VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.
- N. Press fittings for steel pipe 1/2" to 2": Where accepted by local code for specific applications, Cold Press Mechanical Joint Fittings shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing system shall be EPDM or HNBR as appropriate for a defined application. MegaPress system manufactured by VIEGA or approved equal and include "Smart Connect" assurance that unpressed fittings will not hold pressure. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.
- O. Grooved option for copper pipe 2" to 8": Couplings consisting of ductile iron cast housings, complete with a synthetic rubber gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together. Couplings shall be manufactured to connect copper tubing sized tube and fittings (flaring of tube and fittings ends to IPS dimensions is not allowed). Installation ready rigid couplings for direct stab installation without field disassembly manufactured by Victaulic or approved equal.
 - 1. All grooved copper components (including couplings, fittings, valves and accessories) are to be supplied by one manufacturer. Grooving tools shall be of the same manufacturer as the groove components.
 - 2. Copper grooved products shall be shown on the drawings and product submittals and shall be specifically identified with the applicable Victaulic series or style designation.
 - 3. A Victaulic factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation.
- P. At the contractor's option, Schedule 10S roll grooved stainless steel pipe with Victaulic stainless steel fittings and couplings may be used in lieu of soldered copper for pipe sizes

3/4" through 12".

2" Pipe and Smaller:

1. Vic-Press 304™: ASTM A-312 stainless steel housings with ASTM A-276 and A-312 outlets and austenitic stainless steel plain or grooved ends, type 304, complete with synthetic rubber Grade "H" (HNBR) seals rated for applicable services to +210 Deg F (+98 Deg C); or Grade "O" Fluoroelastomer for applicable services to +300 Deg F (+149 Deg C). System shall be rated to 500 psi (3447 kPa) unless noted otherwise.
 - a. Flange Adapters: ANSI Class 150 flange adapter, Van Stone type with stainless steel back-up flange and Vic-Press™ ends. Rated for services to 275 psi (1876 kPa). Victaulic Style P565.
 - b. Unions: Threaded union, 304/304L stainless steel, with Vic-Press™ ends. Victaulic Style P584.
 - c. Vic-Press with HNBR or EPDM seals shall be ANSI/NSF 61 Annex G Certified for Potable Water.
 - d. Vic-Press system shall be FM approved for fire protection services.

Or

2. Vic-Press 316™: ASTM A-312 stainless steel housings with ASTM A-276 and A-312 outlets and stainless steel plain or grooved ends, type 316, complete with synthetic rubber Grade "H" (HNBR) seals rated for applicable services to +210 Deg F (+98 Deg C); Grade "E" EPDM for applicable services to +250 Deg F (+120 Deg C); or Grade "O" Fluoroelastomer for applicable services to +300 Deg F (+149 Deg C). System shall be rated to 500 psi (3447 kPa) unless noted otherwise.
 - a. Flange Adapters: ANSI Class 150 flange adapter, Van Stone type with stainless steel back-up flange and Vic-Press™ ends. Rated for services to 275 psi (1876 kPa). Victaulic Style P566.
 - b. Unions: Threaded union, 316/316L stainless steel, with Vic-Press™ ends. Victaulic Style P585.
 - c. Vic-Press with HNBR or EPDM seals shall be ANSI/NSF 61 Annex G Certified for Potable Water.
 - d. Vic-Press System shall be FM approved for fire protection services.

2-1/2" to 4" Pipe Size:

3. Couplings shall be Installation-Ready, for direct stab installation without field disassembly, with Nitrile grade T gasket rated +180 deg F for compressed air with oil vapors. Victaulic Style 107H (rigid) or Style 177 (flexible). Where required coupling housing galvanized coating may be used.
4. Roll groove stainless steel pipe with Victaulic grooving tools equipped with RX roll sets, specifically designed for stainless steel pipe.
5. A factory trained field representative (direct employee) shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. The coupling manufacturer's representative shall periodically visit the job site and review installation. Contractor shall remove and replace any joints deemed improperly installed.
6. All grooved joint coupling, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the

grooved components.

2.03 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
 - 1. Where pipe materials of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.04 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller. For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.05 GASKETS

- A. High Temperature Piping. Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.
- B. Other Piping. Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.06 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.07 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America unless specifically named in these specifications.

PART 3 - EXECUTION

3.01 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.
- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.

- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.
- E. Press Connections: Copper and steel press fittings ½” through 4” shall be applied in accordance with the manufacturer’s installation instructions. The tubing/pipe shall be fully inserted into the fitting and the tubing/pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing/pipe to assure the tubing/pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. If soldering (thread adapters, etc.) near press fittings, take precautions to not damage the O-ring fittings. Maintain three pipe diameters or use a cooling agent. Viega-“Pro-Press”.

3.02 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.
- F. Bevel ends of ferrous pipe.

3.03 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.04 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe

runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.

- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On cold water pipe, supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion.
- F. Use electro-galvanized or zinc plated threaded rods, nuts, washers and hangers.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Feet	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-	8	5	3/8
	10	5	3/8
	10	5	1/2
	10	5	5/8
	10	5	3/4
2"			
3"			
4" & 5"			
6" and above			

3.05 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.

- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.06 PIPE SUPPORTS ON ROOF

- A. Support gas pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.07 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.08 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.09 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or

ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.

- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.
- B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.
- C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
- D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Flush system and replace with clean water.
- G. Phase Three: Final flushing and rinsing: Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.

- H. Submit status reports upon completion of each phase of work on each system.

3.13 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. Both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION 22 20 00

SECTION 22 33 13
INSTANTANEOUS ELECTRIC WATER HEATER

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Electric water heaters for domestic water systems.

1.02 RELATED WORK

- A. Division 22 Plumbing
 - 1. Domestic Water Piping.
 - 2. Plumbing Piping Insulation.
 - 3. Division 26 Electrical.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Chronomite
- B. EEMAX

2.02 PRODUCTS

- A. Provide tankless, flow switch activated heater.
- B. Hot water temperature range of 103°F to 120°F.
- C. 0.5 GPM flow rate.
- D. Low pressure model if required. Contractor shall verify pressure at site.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install where shown on Drawings and in accordance with manufacturer's requirements.

3.02 WARRANTY

- A. Provide standard manufacturer's 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

END OF SECTION 22 33 13

SECTION 22 33 34
ELECTRIC WATER HEATER (Commercial - Non-ASME)

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Electric water heaters for domestic water systems.

1.02 RELATED WORK

- A. Division 22 Plumbing
 - 1. Domestic Water Piping.
 - 2. Plumbing Piping Insulation.
 - 3. Division 26 Electrical.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Lochinvar
- B. State
- C. Rheem/Ruud
- D. A. O. Smith

2.02 PRODUCTS

- A. Provide electric water heaters with kilowatt, recovery ratings, and storage capacities as scheduled on drawings.
- B. Provide a tank designed for 150 psig working pressure. Furnish glass-lined tank. Lining shall be corrosion-resistant.
- C. Furnish factory-assembled, integral units equipped as follows:
 - 1. Extruded high density anode rod.
 - 2. Individually mounted thermostat at each element with a high temperature cutoff.
 - 3. High temperature limit switch (energy cutout).
 - 4. UL rated.
 - 5. Temperature and pressure relief valve.
- D. Provide medium watt density elements having zinc-plated copper sheathing and prewired leads.
- E. The outer jacket shall be baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation.
- F. Electrical junction box with heavy duty terminal block shall be provided.

- G. Heater shall have a three year limited warranty.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installations shall be in accordance with the manufacturer's published recommendations.
- C. Furnish all supports required by the equipment included in this Contract.
- D. Provide a 4" thick reinforced concrete housekeeping pad beneath heaters.
- E. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.
 - 1. Install a line size shutoff valve in cold water inlet and hot water outlet close to each heater.
 - 2. Provide a temperature gauge in the domestic hot water piping within five feet of outlet to each heater, upstream of all shut-off valves. Size and locate gauges to be easily readable from a standing position.
- F. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.
- G. Route condensate to a vented receiver.
- H. Pipe relief valve discharge and all equipment drains indirectly to appropriate floor drain.
- I. Set the operating and safety controls.
- J. Set thermostats on domestic water heaters to delivery maximum water temperature as indicated on Contract Drawings.
- K. Furnish and install an expansion tank on cold water supply to heater. Locate tank as close to water heater as possible between water heater and all check valves or backflow preventers. Expansion tank capacity shall be as scheduled on Contract Drawings. Install expansion tank in accordance with manufacturer's recommendations.
- L. Install water heater in galvanized drain pan piped to floor drain.

3.02 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant

personnel.

3.03 WARRANTY

- A. Provide standard manufacturer's 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

END OF SECTION 22 33 34

SECTION 22 35 16
INSTANTANEOUS GAS-FIRED TANKLESS WATER HEATERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Tankless gas-fired water heaters for domestic water systems.

1.02 RELATED ITEMS

- A. Division 22 Plumbing:
 - 1. Domestic Water Piping
 - 2. Gas Piping
 - 3. Flue Piping
 - 4. Plumbing Piping Insulation

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Rinnai Corp.
- B. Noritz America Corp.

2.02 PRODUCT SPECIFICATIONS

- A. Commercial tankless, internally mounted, instantaneous, gas fired, direct vent water heater design certified to the ANSI Z21.10.3 / CSA 4.9 wall mounted for indoors or outdoors.
- B. Adjustable hot water temperature range of 90°F to 140°F.
- C. Flow rates of 0.5 gpm up to 9.3 gpm (199 cfh) and 9.1 gpm (180 cfh) models.
- D. Maximum NOx emissions of 55 ppm per South Coast Air Quality Management District (SCAQMD).
- E. Heaters shall be microprocessor controlled (standard digital controller) and utilize a direct electronic ignition system(with no standing pilot) modulating gas valve, flow meter, flow control valve and temperature thermistors to maintain outlet water temperature between +/- 2°F of setpoint temperature.
- F. Safety Devices:
 - 1. Flame failure lockout
 - 2. Boiling protection lockout
 - 3. Thermal overheat protection
 - 4. Freeze protection
 - 5. Lockout protection in the event of a blocked flue.

2.03 FLUE

- A. This water heater(s) shall be suitable for sealed combustion direct-venting air intake pipe and exhaust pipe per manufacturer's instructions. Provide a properly sized thermal expansion tank as scheduled on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install a line size valve in the cold water supply close to each heater and a line size plug cock in the gas supply close to each heater.
- B. Install all flue exhaust and air intake material and manifolds per manufacturer's instructions.
- C. Install according to manufacturer's specifications and pipes as shown.

3.02 WARRANTY

- A. Heat Exchanger: 304 stainless steel burner or copper heat exchanger warranted for 5 years from date of purchase in a commercial application. Three years from date of purchase when used as a circulating water heater with a hot water circulation loop.

END OF SECTION 22 35 16

SECTION 22 40 00
PLUMBING FIXTURES AND FIXTURE CARRIERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install water closets, urinals, lavatories, electric drinking fountains, fixture carriers and plumbing appurtenances.

1.02 RELATED WORK

- A. Division 22 Plumbing
 1. Drains, Hydrants and Cleanouts.
 2. Domestic Water Piping.
 3. Soil, Waste and Sanitary Drain Piping and Vent Piping.

1.03 JOB REQUIREMENTS

- A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Plumbing Fixtures (Vitreous China):
 1. American Standard.
 2. Kohler.
 3. Toto
 4. Zurn
- B. Plumbing Faucets:
 1. American Standard.
 2. Chicago.
 3. T&S Brass.
 4. Zurn.
 5. Symmons
 6. Speakman
 7. Moen Commercial
- C. Supports and Carriers:
 1. Wade
 2. Zurn
 3. J.R. Smith.
 4. Josam.
 5. Watts
- D. Flush Valves:

1. Sloan
 2. Zurn
 3. Moen Commercial
- E. Supplies, Stops and Chrome Plated Tubular Brass:
1. McGuire
 2. Kohler
 3. Chicago
 4. Zurn
- F. Water Closet Seats:
1. Beneke
 2. Church
 3. Olsonite
 4. Bemis
 5. Centoco
- G. Electric Drinking Fountains:
1. Halsey Taylor
 2. Elkay
 3. Oasis
 4. Haws
- H. Floor Drains:
1. Wade
 2. J.R. Smith
 3. Josam
 4. Zurn
 5. Watts
 6. Sioux Chief
- I. Cleanouts:
1. Wade
 2. J.R. Smith
 3. Josam
 4. Zurn
 5. Watts
- J. Shower Systems:
1. Bradley
 2. Acorn
 3. Willoughby
- K. Shower Valves
1. Chicago
 2. Acorn
 3. Symmons
 4. Bradley
 5. Moen Commercial
- L. Shower Stall

1. Aquabath
 2. Aquatic
 3. Aquarius
 4. Best Bath Systems (Access)
- M. Stainless Steel Sinks:
1. Elkay
 2. Just
 3. Griffin
 4. Moen Commercial
 5. Amtekco Industries
- N. Mop Sinks:
1. Crane Fiat
 2. Stern Williams
 3. Acorn
 4. CECO
- O. Service Sinks:
1. American Standard
 2. Kohler
 3. Eljer
 4. CECO
- P. Roof Drains:
1. Wade
 2. J.R. Smith
 3. Josam
 4. Zurn
 5. Watts
- Q. Thermostatic Mixing Valves
1. Lawler
 2. Symmons
 3. Leonard
 4. Powers
 5. Holby
 6. Bradley
- R. Emergency Safety Equipment
1. Speakman
 2. Bradley
 3. Encon
 4. Guardian
 5. Haws
- S. Shock Arrestors:
1. Precision Products
 2. Sioux Chief
- T. Backflow Preventors

1. Watts
 2. Febco
 3. Wilkins
 4. Beeco
- U. Hose Bibbs
1. Wade
 2. Chicago
 3. Josam
 4. Woodford
 5. Zurn
 6. J.R. Smith
- V. Wall Hydrants
1. Wade
 2. Woodford
 3. Zurn
 4. J.R. Smith
 5. Josam
- W. Solids Interceptors
1. Wade
 2. J.R. Smith
 3. Zurn
 4. Josam
 5. Schier

2.02 REQUIREMENTS

- A. Refer to the drawings for equipment to be supplied.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions.
- B. Make rough-in and final connection of service to each fixture provided under this Section and other Sections or Architectural or Plumbing Drawings.
- C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation.
- D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on drawings.
- E. Remove piping and services roughed-in incorrectly and install correctly, without cost.
- F. Exposed piping, fittings and appurtenances shall be chrome-plated brass.
- G. Coordinate with the Contractor for locations and service required for each plumbing fixture.

- H. All floor drains and floor sinks shall have trap primer connections. Provide trap primer valves and 1/2-inch water line to each floor drain connection. Trap primer supply line shall have ball valve and Y strainer on inlet side of trap primer valve to facilitate cleaning.
- I. All floor drains and floor sinks shall have Pro-Set "Trap Guard" for trap seal protection.
- J. All floor drains and floor sink locations are to be coordinated with all equipment. Locate drains in mechanical equipment spaces to conform to drain locations of equipment furnished. Coordinate drain location with food service equipment and Architectural Drawings.
- K. All floor drains, floor sinks and cleanout covers are to be provided with stainless steel vandal resistant screws.
- L. Trap primer valves installed in concealed spaces shall have approved access doors for accessibility.

END OF SECTION 22 40 00

SECTION 22 63 11
GAS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install steel gas pipe inside buildings, including the supply line from the meter, service lines to gas equipment and appliances, termination of the service line with a plug valve, drip leg, and final connection to equipment and appliances with unions.
- B. Coordinate service line from utility main and extend to meter. Coordinate installation of the service line and meter with Gas Company.
- C. Extend steel gas piping from meter to inside the building to all fixtures, appliances and equipment requiring gas.

1.02 RELATED WORK

- A. Division 22 Plumbing
 - 1. Plumbing Pipe and Fittings
 - 2. Valves and Vents

1.03 UTILITY CONNECTIONS

- A. Make arrangements for and pay all fees and connection charges for obtaining service to the building.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS - ABOVE GRADE

- A. Pipe 2 inch and Smaller:
 - 1. Schedule 40 ASTM A 53 black steel pipe
 - 2. Factory fabricated socket weld fittings.
 - 3. Where approved for a specific project and where accepted by local code, cold press mechanical joint fittings shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing elements shall be HNBR and the fittings shall bear the CSA stamp to confirm acceptability for fuel gas systems. MegaPress system manufactured by VIEGA including "Smart Connect" to assure unpressed fittings will not hold pressure. Installers shall carry training credentials from the manufacturer to confirm they have been instructed in the correct installation procedures.
- B. Pipe Larger than 2 inch:
 - 1. Schedule 40 ASTM A 53 black steel pipe.
 - 2. Factory fabricated butt weld fittings for welded steel pipes shall conform to ASTM A-234 WPB (seamless weld fittings).
- C. Unions:
 - 1. Standard 150 lb. (300 lb. water, oil or gas) malleable iron.
 - 2. Ground joint unions, with bronze seat.
 - 3. Flange joints for pipe larger than 2 inch in diameter.
- D. Flanges:
 - 1. Steel flanges. ANSI B16.5 and ASTM A-105.

2.02 PIPE AND FITTINGS - BELOW GRADE OUTSIDE BUILDING

- A. Polyethylene pipe shall be ASTM D3350 Grade PE24 cell classification and ASTM D1248 Class B material classification.
- B. Pipe shall be medium density polyethylene PE 2406 and PE 2708 manufactured by Poly Pipe Industries, Inc. or Performance Pipe.
- C. Polyethylene yellow molded butt fittings for use with medium density polyethylene pipe shall meet testing requirements of ASTM D2513 and resin material listing of ASTM D3350 with PPI designation of PE 2406 as manufactured by Central Plastics Co.

2.04 VALVES

- A. See Section 22 05 23.

2.05 GAS PRESSURE REGULATOR

- A. Size the gas pressure regulator in accordance with the manufacturer's recommendations for flow quantities and reduced pressure as required for all equipment. Coordinate final equipment gas pressure requirements prior to ordering regulators. Provide American Meter Company regulators or approved equal, suitable for outdoor installation. Regulators outside exposed to weather shall be installed with vent in vertical down position.
- B. All line pressure regulators shall be listed in accordance with ANSI (American National Standard) Z21.80 and CSA (Canadian Standards Association Standard) 6.22.
- C. Where a line pressure regulator has an inlet pressure over 2 psi and serves an appliance rated for ½ psi (14" of water column) or less, a downstream overpressure device (OPD) must be installed in accordance with ANZI Z21.80.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation Standards: Install gas piping in accordance with recommendations of the National Fire Protection Association.
- B. Drip Legs: Install a capped drip leg 6 inches long at the base of each vertical rise.
- C. Coating and Wrapping. Coat and wrap underground piping in accordance with the service utility company standards.
- D. Sleeves.
 - 1. Encase gas piping running in or through solid partitions with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.
 - 2. Encase gas piping running below slab in Schedule 40 PVC, minimum size two pipe sizes larger than gas pipe. Vent sleeve to atmosphere with a 1-1/2 inch vent with 1-1/2 inch return bend above building roof. Seal ends of sleeve with UL fire rated caulk.
- E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.
- F. Weld all gas piping above grade.

- G. Provide test ports and isolation valves to enable proper testing of system in the future.
- H. Provide isolation valve and unions across regulators for proper removal.
- I. Provide transition risers where below grade polyethylene pipe changes to steel pipe above grade.
- J. Gas Pressure Regulators / Vents:
 - 1. Piping shall be sized in accordance with the regulator manufacturer's instructions. Never use pipe sizes smaller than the vent size; smaller pipe sizes restrict the gas flow. Where there is more than one regulator at a location, each regulator shall have a separate vent to the roof / outdoors. Headers with various installed devices can cause regulator malfunction.
 - 2. Support the vent pipe to eliminate strain on the regulator diaphragm case.
 - 3. Install vent piping from regulators to location to prevent gas smells from entering building. Do not locate the vent line terminus near windows, fans, or other ventilation equipment. See the installation instructions furnished with the regulator.
 - 4. Install double elbows and insect screen at end of piping to prevent moisture and insects from entering. Always point outdoor vent pipes in the downward position to reduce the possibility of rain, snow, sleet, and other moisture entering the pipe.
 - 5. When installed inside building route vents horizontally and terminate through building sidewall. The vent must be piped to the outside atmosphere using the shortest length of pipe, the fewest possible pipe elbows, and a pipe diameter as large as the vent size or larger. If a long gas run must be used, increase the pipe one nominal size every ten feet to keep the flow restriction as low as possible. Vents terminating through roof must have prior approval from Architect before installation. Through roof penetrations shall be minimized.
 - 6. Regulators installed outside or on roof top: Install regulator vent turned downward with insect screen over vent opening. The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.
 - 7. Ensure the end of the vent line is away from ANY potential ignition sources. It is the installer's responsibility to ensure the vent line is exhausting to a safe environment
 - 8. Adhere to all applicable codes and regulations.
 - 9. All over pressure protection devices (OPD) shall be vented to the exterior.

3.02 TESTING GAS PIPING

- A. Preliminary gas test as required by Code, but minimum test pressure of 50 PSI held for not less than eight hours without noticeable drop.
- B. Test joints with a soap solution while lines are under pressure.
- C. Repair leaks.
- D. Final gas test shall be with a 24 inch column of mercury or a diaphragm gauge with a minimum dial size of 3-1/2 inches with a set hand and a pressure range not to exceed twenty (20) psig with 2/10-pound increments. The minimum test pressure shall not be less than ten (10) psi and the maximum test pressure shall not exceed twelve (12) psig. This test will be observed for no less than (30) thirty minutes with no drop in pressure.
- E. Provide copy of gas pressure test reports in Operations & Maintenance Manual.

- G. School renovations projects shall have all gas piping tested. Report and document gas leaks found to the Architect and Engineer. Repair leaks at no additional cost to the Owner.

3.03 IDENTIFICATION CONDUCTOR

- A. Spiral A #12 AWG insulated copper conductor the full length of the thermoplastic piping system. Fasten to the pipe at 3 foot intervals with plastic tie wraps.
- B. Terminate at each end in a 12 inch x 12 inch x 4 inch FRP junction box.
 - 1. Bolted gasketed cover with stainless steel screws.
 - 2. Screw type terminal strip.
 - 3. Legend on cover "gas pipe identification conductor."
- C. Set in concrete pad.

3.05 PAINT EXPOSED OUTSIDE GAS PIPE

- A. Interior and Exterior Gas piping shall be protected from rust.
- B. Paint pipe with a flat alkyd coating, clean pipe prior to painting by preparing surface by hand tool cleaning per SSPC-SP2-82, applying one coat of Glidden Y-590 Rustmaster Metal Primer White and top coat of Yellow Alkyd Flat Enamel.

END OF SECTION 22 63 11

SECTION 23 01 00
HVAC OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.02 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Schedule of filters for each item of equipment.
 - 11. Schedule of belts for each item of equipment.
 - 12. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit three (3) completed manuals in final form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.

- F. Two (2) complete Manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.01 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.01 OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer.
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement.
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds.
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems.
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts.
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

- 1) Predicted life of part subject to wear.
- 2) Items recommended to be stocked as spare parts.
- h. As installed control diagrams by controls manufacturer.
- i. Complete equipment internal wiring diagrams.
- j. Schedule of filters for each air handling system.
- k. Schedule of belts for each item of equipment.
- l. Each Contractor's coordination drawings.
- m. As installed color coded piping diagrams.
- n. Charts of valve tag number, with location and function of each valve.
- o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
- p. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 23.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide extended compressor warranty certificates.

END OF SECTION 23 01 00

SECTION 23 05 00
MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.
- B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.02 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Mechanical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Americans with Disabilities Act Standards
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.03 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.04 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified

capacities.

1.05 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.06 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations and sizes of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of the project, obtain without cost to the Owner, copies of the original drawings and transfer as-built changes to these. Provide a hard copy of this As-Built Set for the owner's records. The As-Built Set must include all drawings, regardless of whether corrections were necessary. Digital copies of the As-Built Set shall be provided to the architect and engineer. Digital drawings shall be in PDF format. The delivery of the As-Built Set is a condition of final acceptance.
- C. Drawings in the As-Built Set should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground mechanical piping and elevation.
 - 7. Indicate exact location of all underground electrical raceways and elevations.
 - 8. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 9. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 - 10. Exact location of all electrical equipment in and outside of the building.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.07 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.08 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other

Divisions of these specifications to determine their requirements.

- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.09 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of

equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.02 AIR FILTERS AND PIPE STRAINERS

- A. Immediately prior to substantial completion of the project, inspect, clean and service air filters and strainers. Replace air filters.

3.03 LUBRICATION, REFRIGERANT AND OIL

- A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.
- B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.

- C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

3.04 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing building slab
- D. Install concrete curbs around duct penetrations or multiple pipe penetrations.

3.05 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of _____ hours dedicated instructor time.
 - 2. _____ hours on each of _____ days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.06 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, air handling units, fan coil units, variable volume boxes, fans, pumps, boilers and chillers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.07 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.08 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.09 INDOOR AIR QUALITY

- A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and

fans.

- B. Practice source control and eliminate potential contaminants in material selection, installation, and maintenance.
- C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.
- D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.
- E. Utilize manufacturer's recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if required.
- F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.
- G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.
- H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

END OF SECTION 23 05 00

SECTION 23 05 10
HVAC CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.02 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.03 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.04 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step, in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.05 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.06 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.

- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.01 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.01 PROTECTION OF EQUIPMENT

- A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials that may trap condensate and cause corrosion.

END OF SECTION 23 05 10

SECTION 23 05 11
MECHANICAL ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.03 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or the modification of existing operational systems.

1.03 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) which do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.

- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.
- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation and, when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Verify actual HVAC supply and return piping connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.02 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems and HVAC coils prior to installation and reuse.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.03 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping, ductwork and connections to maintain existing systems in service during construction.
- C. Existing HVAC and Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the

facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.

- D. Remove and replace existing Mechanical systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.
- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping, grilles, boxes and ductwork coincident with the construction.
- G. Remove or relocate existing piping, grilles, ductwork or housekeeping pads as occasioned by new or remodeled construction. Cap unused HVAC or domestic piping and duct beyond the new finish line.
- H. Relocate all HVAC and or domestic piping, grilles, boxes and ductwork as required to accommodate new work requiring precedence.
- I. Remove concrete housekeeping pad where materials or equipment have been removed.
- J. Remove all known utilities which do not provide service to the buildings that remain unless otherwise instructed in the construction documents.
- K. Remove existing plumbing or mechanical vent penetrations through roof not to be reused.

3.04 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the

Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.

- D. HVAC, Plumbing, piping, ductwork and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping and ductwork not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing mechanical installations, or as specified.
- H. Existing mechanical piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.05 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.06 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing mechanical equipment in renovated areas as specified in Section 23 05 00 Mechanical General Provisions.

3.07 REFRIGERANT DISPOSAL

- A. Contractor shall dispose of refrigerant from all DX equipment including refrigerant piping per OSHA, EPA, Federal, State and Local Codes.

END OF SECTION 23 05 11

SECTION 23 05 12
SHOP DRAWINGS, COORDINATION DRAWINGS AND PRODUCT DATA

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Prepare submittals as required by these specifications as outlined below.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.02 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.03 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}" = 1'-0"$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment

- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.04 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.05 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.06 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.

- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.07 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and contact number.
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier

- d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.08 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.09 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.

- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 23 05 12

SECTION 23 05 13
ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for mechanical equipment.
 - 2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
 - 5. Wiring of smoke detectors for shutdown of air handling equipment when a fire alarm system is not included in the project.
 - 6. Wiring of oil pump, vibration and oil level limit switches for cooling towers.
 - 7. Refrigerant monitor/sensor/alarming and field installed visual/audible display alarms.
 - 8. Pipe heat tracing.
 - 9. Cooling tower vibrations switch/interlock/reset.
 - 10. Field interlock wiring from chiller: flow switches, pump aux. Controls, pump start/stop.
 - 11. Power supply 120 VAC and control signal from chiller control panel to condenser water flow control valve installed in piping leaving chiller.
 - 12. Wiring of all related circulating water system chemical treatment devices.
 - a. Low voltage electric contacting water meter.
 - b. Solenoid valve/blow-down assembly.
 - 13. Radiant heater timer switches and/or thermostats.
 - 14. Low Voltage thermostat wiring.
- C. Refer to Division 23 Controls Sections for related control system wiring.
- D. Refer to Division 23 sections for specific individual mechanical equipment electrical requirements.
- E. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.
- F. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.03 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.04 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.01 MOTORS

- A. Provide motors for mechanical equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
 - 9. WEG
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of mechanical equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of mechanical work:
- C. Temperature Rating. Rated for 40 Degrees C environment with maximum 50 Degrees C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors

until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.

- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure requirements.
 - 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 - 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.
- I. Provide an inverter duty motor on all equipment that utilizes a variable frequency drive.

2.02 EQUIPMENT FABRICATION

- A. Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

2.03 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

- A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR's Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.
- B. Application Note: Motors up to 100 HP shall be provided with one shaft ground ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor.

Grounding rings shall be provided and installed by the motor manufacturer's recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION 23 05 13

SECTION 23 05 14
HVAC CONDENSATE DRAIN PIPING SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide and install air conditioning condensate drains.

1.02 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Insulation
 - 2. Fan/Coil Units
 - 3. Air Handling Units
 - 4. Chilled Water Pumps
 - 5. Air Compressor Storage Tanks
 - 6. Equipment Drain Pans
 - 7. Heat Pump Units

PART 2 - PRODUCTS

2.01 PIPE MATERIAL

- A. Type "L" copper with drainage pattern fittings in plenum areas. Type PVC with drainage pattern fittings in non-plenum areas.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the system to facilitate easy removal.
 - 1. Use threaded plugged tee at each change of direction to permit cleaning.
 - 2. Install a cleanout every 50 feet of straight run piping
 - 3. Maintain a positive slope on all piping
- B. Install a water seal trap leg based on the fan pressure.
 - 1. Size the length of the trap leg 1 inch larger than the actual system pressure.
- C. Install traps and cleanout as shown in the drawing details.
 - 1. Confirm requirements with manufacturer's installation instructions

3.02 SIZE PIPE AS SHOWN ON DRAWINGS.

- A. Do not install piping sized smaller than the unit drain connection size.

3.03 SECONDARY DRAINS

- A. Provide secondary drains where required by code, shown on the drawings, or where equipment has secondary drain connections.

END OF SECTION 23 05 14

SECTION 23 05 17
HVAC ACCESS DOORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, fire dampers, air distribution devices and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.01 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock & cylinder lock for Owner selection
- E. Automatic closing and latching mechanism
- F. Prime coat finish
- G. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation
- H. Material suitable for wall and/or ceiling mounting

2.02 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish

- J. Material suitable for wall and/or ceiling mounting

2.03 ACCEPTABLE MANUFACTURERS

- A. Milcor
- B. MIFAB
- C. Acudor
- D. Elmdor

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Access doors specified in Division 23 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 36" x 24" for Mechanical HVAC equipment related items
 - 2. 18" x 18" for electrical related items

END OF SECTION 23 05 17

SECTION 23 05 18
VARIABLE FREQUENCY INVERTER

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install a variable frequency inverter for the following equipment items.
 - 1. Variable Volume Air Handling Units.
 - 2. Pumps.
 - 3. Cooling Towers.

1.02 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical to ensure that intended functions are achieved and proper equipment is provided.
- B. Coordinate the size of the variable frequency inverter with the equipment being served by the inverter. The rated current output amps are to be equal to or greater than motor rated full load amps.

1.03 SUBMITTALS

- A. Submit manufacturer's information and shop drawings as specified.
 - 1. Complete technical details.
 - 2. Dimensions and manufacturer's installation manual.
 - 3. Schematic diagrams of the circuitry and field connections.
 - 4. Manufacturer's start-up manual.

1.04 STANDARDS

- A. UL.
- B. CSA.
- C. ISO 9001
- D. NEC.
- E. FCC.

1.05 WARRANTY

- A. The manufacturer shall provide a full parts and labor warranty for a period of five (5) years from substantial completion.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ABB

B. Danfoss Graham

C. Yaskawa

2.02 CABINET

A. The inverter and all accessories shall be provided within a wall mounted UL Listed NEMA 12 enclosure with deadsides and removeable gasketed doors with provisions for locking. Cabinet shall be constructed of metal for reduction of radio frequency interference (RFI) and electromagnetic frequency interference.

2.03 INTERFERENCE WITH OTHER SYSTEMS

A. The inverter shall be designed and constructed to comply with IEEE Standard 519-1993 with respect to line noise and RFI generation. All units shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in Table 1.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

B. Dual DC Bus filtered chokes (factory installed and wired in the drive enclosure) equivalent to 5% input line reactors shall be provided to minimize harmonics reflected onto the input line.

1. Shall not interfere with computer and other electronic systems in the building.
2. If not inherently protected, provide a suitable isolation transformer.
3. The system shall not produce spikes on the incoming line.

C. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.

2.04 PROTECTIVE CIRCUITS

A. Provide the following protection:

1. Input line fuses or molded case circuit breaker rated at 100 AIC.
2. Input line noise suppression with MOV's (metal oxide varistors) and snubber circuits. MOV's shall be provided across incoming line terminals, AC input reactors, DC choke filters, and transistors to protect inverter from voltage surges and spikes.
3. Protection of solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent overcurrent trip due to momentary overload conditions.
4. Current limiting DC buss fuse between input and output sections of inventor.
5. Input overvoltage trip at 480 vac + 10% trip.
6. Input undervoltage at 480 vac – 10% trip
7. Instantaneous overcurrent protection of solid state inverter devices.
8. Individual overcurrent protection of solid state inverter devices.
9. Output overvoltage trip.

10. Loss of input phase, phase reversals, or blown fuse.
11. Thermal overload trip for overload protection of solid state devices.
12. Ground fault protection on start-up.
13. Output line to line short circuit protection.
14. Phase to phase short circuit or severe overload conditions of output.
15. Overload of motor.
16. Frequency stall.
17. DC buss high voltage.
18. Control function error.
19. Heatsink over temperature (Max. operating ambient: 122 degrees F)
20. Controller able to operate without a motor or any other equipment connected to the output (To facilitate startup and troubleshooting).
21. Capable of restarting into a rotating motor without component damage.
22. Shut down safely without component failure in the event of a sustained power loss, and will automatically return to normal operation, if start is "on" and power is restored.
23. Shut down safely without component failure in the event of a momentary power loss. Automatically return to normal operation if the start is "on", and normal power is restored. Capable of establishing speed control without shutdown or component failure.
24. Designed for input power contactor opening or closing while control is activated, without damage to the controller.
25. Automatically reset trip resulting from overcurrent, undervoltage, overvoltage, or over temperature, and automatically restart after removal, or correction of the faulty condition.
26. Provide status lights or digital display for indication of failure conditions, and form C relay provided for remote indication. Digital display or status lights to indicate power on, at speed, and drive enabled.
27. Operation and fault diagnostic function circuits shall be built into each inverter that provides information in determining the cause and source of a fault.
Diagnostics to provide the following information:
 - a. Operating mode at trip (Accel, Decel, Constant speed).
 - b. Output current at trip.
 - c. Output voltage at trip.
 - d. Additional faults that occurred simultaneously or immediately before displayed tripped.Any drive requiring separate card to provide this information shall provide a diagnostic card for each drive.
28. DC link reactor.
29. Input power disconnect, lockable type.
30. Input power disconnect switch / circuit breaker, with lockable type handle.

2.05 OPERATOR DEVICES

- A. The following operator devices shall be door or remote mounted:
 1. Digital keypad and LCD provided to perform all parameter adjustments, operation monitoring, and operation programming.
 2. Power on indication light.
 3. Flush mounted meters or digital display to indicate output voltage, output frequency, and output current, in percent of maximum 0 to 100%.
 4. Manual/Off/Auto 3 position selector switch (hand-off-auto) and manual speed

setting control to provide the following control sequences:

- a. In automatic mode, controller shall follow an external control signal and respond to remote start-stop contact.
 - b. In manual (hand) mode, controller shall follow speed signal set via door mounted keypad and start/stop switch. Switching from "hand" to "auto" and vice versa shall require a single keystroke to a dedicated changeover key. Inverters requiring multiple keystrokes and/or reprogramming of internal parameters to accomplish changeovers are not acceptable.
 - c. An integral "safety interlock" protection shutdown circuit shall be provided for interface with firestats, smoke detectors, high static pressure limit switches, vibration switches, etc.
5. Programmable lockout code to prevent unauthorized programming.
 6. Critical frequency avoidance capability (up to 3 resonant points).

2.06 FIELD ADJUSTMENTS

- A. The following shall be adjustable in the field:
 1. Maximum Speed: 0 to 125% adjustable.
 2. Minimum Speed: 0 to 100% adjustable.
 3. Acceleration/deceleration rates: 0 to 3600 sec.
 4. Instantaneous overcurrent trip: 50% to 2000%.
 5. Volts/hertz ratio: Field adjustable to 16 patterns or set for automatic selection of proper V/F load profile to operate motor without overdriving or overloading.
 6. Current limit circuit: 60 to 100%.
 7. Carrier frequency: 6 to 16 KHZ.
 8. Control interface: selectable to follow a 0-5 VDC, 0-10 VDC, 4-20 MA, either direct or indirect acting.
 9. Control signal Bias: 0 to 80 HZ.
 10. Control signal gain: 0 to 80 HZ.
 11. Calibration of remote speed signal: 0 to 80 HZ.

2.07 ELECTRICAL CONSTANT SPEED BYPASS

- A. Provide all components and circuitry necessary to provide manual bypass of the inverter. The bypass package shall be mounted in a cabinet common with the inverter and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode. Manual bypass shall contain the following:
 1. Two contactors mechanically interlocked via a three position through the door selector switch to provide the following control:
 - a. "Inverter" Mode connects the motor to the output of the inverter.
 - b. "Bypass" Mode connects the motor to the input sine wave power. Transfer must occur with input disconnect open. Motor is protected via thermal overload.
 - c. "Off" Mode disconnects motor from all input power.
 2. A molded case circuit breaker or fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
 3. An input contactor, interlocked with both the thermal motor overload and external safeties which disconnects power to the motor regardless of the mode of operation (either "inverter" or "bypass" mode).
 4. A thermal overload to provide protection of motor in the bypass mode.

5. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation – “inverter” or “bypass”) in response to a signal from the thermal overload and/or external safety circuits.
6. Line voltage to 24 volt DC power source, fused per NEC, shall provide power to all bypass control circuits.

2.08 SERIAL COMMUNICATIONS

- A. The VFD shall have the capability of communicating with a building management control system via an RS-485 serial port.
- B. VFD shall be provided with protocol information specific to the selected BMCS manufacturer and shall be pre-configured at the factory to automatic communications, without the need for field programming.
- C. Serial communications capabilities shall be included, but not limited to: run/stop control, speed set adjustment, proportional/integral or PID control adjustments, current limit and accel/decel time adjustments. The drive shall also have the capability of allowing the DDC system to monitor the following feedback signals: process variable, output speed/frequency, current, torque, power (KW), operating hours, kilowatt hours; relay outputs, and diagnostic warning and fault information.
- D. The VFD shall allow the DDC system to control the drive’s digital and analog outputs and monitor all drive digital and analog inputs via the serial interface.
- E. Provide BACnet interface card.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation as per manufacturer's recommendations and requirements.
 1. Inverter chassis is properly grounded.
 2. Line, Load, Control, and Fire/Safety wiring are installed in separate conduits.
 3. Both ends of conduit entering and leaving VFD into AHU cabinets and motors must be sealed air tight.

3.02 MANUFACTURER START-UP SERVICE

- A. Factory trained personnel shall be provided for start-up assistance, minimum (1) day per unit.
 1. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents.
 2. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
 3. Adjustable devices, components, and assemblies to assure optimum performance.
 4. Make final adjustments to the installed drive to assure proper operation of the fan system. Obtain performance requirements from installer of driven loads.

5. Assistance will be provided to the Owner (upon request) to determine the optimum capacitance for per factory correction and avoidance of potential resonance problems and will determine optimum line filter required.
 6. A written report, duly signed by the technician detailing set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.
- B. Input DC voltage to dry motor windings when fan is not in operation at the following locations:
1. Cooling tower fan motor
 2. Motors downstream of coils
 3. Rooftop unit motors

3.03 DEMONSTRATION AND TRAINING

- A. Provide system demonstration to personnel, Owner, and/or Owner's selected representatives.
- B. Demonstrate operation of controllers in the automatic and manual modes.
- C. Provide a minimum of two days of technical training for the owner's operating and technical staff. Schedule training with owner's authorized representatives, during normal business hours and not less than 30 days prior to planned session. Coordinate with training required per 23 05 00 Mechanical General Provisions.
- D. Training may be consecutive or random, at Owner's option.

END OF SECTION 23 05 18

SECTION 23 05 19
HVAC PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.02 RELATED WORK

- A. Division 23, Mechanical
 - 1. 23 05 00 - Mechanical General Provisions
 - 2. 23 20 00 - Pipe and Pipe Fittings, General
 - 3. 23 05 23 - Valves, Strainers and Vents
 - 4. 23 21 13 - Hot Water and Chilled Water Piping, Valves and Appurtenances
 - 5. - Steam and Condensate Piping and Valves
 - 6. 23 21 24 - Condenser Water Piping, Valves and Appurtenances

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

- A. Terice
- B. Taylor
- C. Marsh
- D. Weksler
- E. Marshalltown
- F. Weiss
- G. Miljoco

2.02 PRESSURE GAUGES

- A. Case and Ring: 4" type 304 stainless steel; liquid filled case with stainless steel bayonet ring.
- B. Dial: White aluminum with black markings
- C. Window: Clear acrylic
- D. Tube: Phosphor bronze and forged brass socket.
- E. Gauge accuracy: +/- 1% over operating range.

- F. For pulsating service, provide impulse dampers.
- G. Without flange for pipe mounting.
- H. With flange for wall mounting.
- I. Weiss Model: LF44S-1B or equal.

2.03 THERMOMETER WELLS

- A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
- B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
- C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
- D. Wells shall be sized to extend a minimum of 50% into pipe.

2.04 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

- A. Die cast aluminum case with baked epoxy finish.
- B. Adjustable angle 9" scale length.
- C. Clear acrylic window.
- D. Brass stem, length to match well.
- E. Red reading organic spirit filled-in magnifying glass column.
- F. White background with black figures and markings.
- G. Brass stems and union connections.
- H. Accuracy: +/- 1% of scale range.
- I. Range:
 - 1. Hot water lines: 30°F to 240°F.
 - 2. Chilled water lines: 0°F to 100°F or 120°F
 - 3. Condenser water: 0°F to 100°F.

2.05 PRESSURE AND TEMPERATURE TEST STATIONS

- A. "Test Station" fitting to receive either a temperature or pressure probe. Fitting shall be solid brass with two valve cores of Nordel.
 - 1. Fitted with a color coded cap strap with gasket.
 - 2. Acceptable Manufacturer: Peterson Equipment Company.
 - 3. Provide with extension neck to match insulation thickness.
- B. Provide to the Owner a fitted case with:

1. Two 0-100 psi pressure gauges as specified and adapters with 1/8" OD probe.
2. Four 5" stem pocket testing thermometers.
 - a. Two with range 25°F to 125°F for chilled water and condenser water.
 - b. Two with range 0°F to 220°F for hot water.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with drawing details and manufacturer's recommendations.
- B. Provide a ball valve at each gauge.
- C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.
- D. Install gauges in the following locations: across pumps, chiller cooler and condenser, storage tanks, heat exchangers.
- E. Test wells for automatic temperature controls shall be furnished by Building Management Control Section and installed by Mechanical Contractor.
- F. Install thermometer in the following locations: Across chiller cooler and condenser, storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, common chilled and hot water lines.
 1. Hot water lines: 30°F to 240°F.
 2. Chilled water lines: 0°F to 100°F or 120°F
 3. Condenser water 0°F to 100°F.

END OF SECTION 23 05 19

SECTION 23 05 20
FLOW METERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install flow meters. This Specification applies to Division 23. Flow meters for control functions are specified in the Controls Section, and are to be supplied under the work of that Section.

PART 2 - PRODUCTS

2.01 FLOW ELEMENTS

- A. Provide and install annular elements, complete with bar stock valved connections for piping to flow transmitter. Furnish quick-disconnect valves and bar stock shutoff valves for connection to portable meter. Construct elements of 316 stainless steel. Provide annubars manufactured by Ellison or equal.
- B. Furnish a metal identification tag and chain giving pipe size, design flow rate, meter reading at design flow rate, metered fluid and station number.
- C. For station sizes 1/2" through 1-1/2", use Ellison 71 nipple section type. For station sizes 2" and larger, use Ellison 73 or 75 standard insert type.
- D. Select flow sensors so that the design flow rate occurs between 10 and 40" of water pressure differential with permanent pressure loss of not more than 5" of water. An accuracy of plus or minus 2.5% of actual flow rate from 40 to 120% of design flow rate is required.
- E. Acceptable Manufacturers:
 - 1. Taco.
 - 2. Paco.
 - 3. Annubar.
 - 4. Preso.
 - 5. Barco.
 - 6. BIF.
 - 7. Venturi.

2.02 FLOW ELEMENTS (optional)

- A. Furnish and install venturi flow stations, complete with bar stock valved connections for piping to flow transmitter. Provide quick-disconnect valves and bar stock safety shutoff valves for connection to the portable meter.
- B. Provide a brass identification tag on the chain giving the pipe size, venturi series, station identification, and meter reading at the specified flow rate.
- C. For 3/4" through 2" size, use one-piece brass screwed venturi station. Make sizes 2-1/2"

through 8" of plated cast iron with a venturi insert held between specially machined, self-centering, 150 lb. steel plate with welding ends.

- D. Select venturi size and series so that the design flow rate occurs between 10 and 40" of water pressure differential and with permanent pressure loss of not more than 25% of indicated flow rate differential pressure. An accuracy of plus or minus 3% of actual flow rate from 40 to 120% of design flow rate is required.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with Manufacturer's written instructions.

END OF SECTION 23 05 20

SECTION 23 05 23
HVAC VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. HVAC Valves
- B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.01 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450°F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Liners, inserts and discs shall be suitable for the intended service.
 - 3. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.
- C. Balancing Valves
 - 1. Provide balancing valves with:
 - a. Corrosion resistant plug with resilient seal when required.
 - b. O-ring stem seal.
 - c. Permanently lubricated, corrosion resistant bearings.
 - 2. Connections
 - a. Through 2" pipe size use threaded connections.
 - b. For valves 2-1/2" pipe size and larger shall be provided with 150 psig flange connections.
 - 3. Provide each valve with:
 - a. Memory stop.
 - b. Plastic drip cap.
 - c. 1/8" gauge tap.
- D. Ball Valves
 - 1. Provide ball valves with:
 - a. Blowout proof stem.
 - b. Full size port, 316 stainless steel ball and stem.
 - c. Cast bronze body.
 - d. Threaded ends.
 - 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
 - 3. Service rating:
 - a. 150 psi saturated steam.

- b. 600 psi WOG.
 - 4. Where piping is insulated, ball valves shall be equipped with 2" extended handles of non-thermal conductive material. Provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.
 - 5. Provide with memory stop for balancing valves.
- E. Valve Connections
 - 1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
 - 2. Thread pipe sizes 2" and smaller.
 - 3. Flange pipe sizes 2-1/2" and larger.
 - 4. Use screw to solder adapters for copper tubing.
 - 5. Use grooved body valves with mechanical grooved jointed piping.
- F. Valve Operators
 - 1. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6" and larger.
 - b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4" and smaller.
 - d. Provide worm gear operators on discharge side of pumps for balancing, for all sizes of valves.
 - e. All valves 2-1/2" and larger provided by Milwaukee Valve shall be provided with gear operators.
- G. Acceptable Manufacturers
 - 1. Dezurik
 - 2. Crane
 - 3. Nibco
 - 4. Keystone
 - 5. Milwaukee Valve
- H. Check Valves
 - 1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
 - 2. Iron body, 2-1/2" and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug.
 - 3. Acceptable Manufacturers
 - a. Mission Duocheck
 - b. Nibco
 - c. Keystone
 - d. Milwaukee Valve
- I. Provide valves of same manufacturer throughout where possible.
- J. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.

- K. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.
- L. Provide valve, seat and trim materials suitable for the intended service.
- M. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, caged or ball type.
- N. Condenser Water Basin Float Valve:
 - 1. Ductile Iron valve, body and cover
 - 2. Stainless steel trim
 - 3. Fully adjustable high and low level settings
 - 4. Stainless steel float, float linkage and float rod
 - 5. Flow clean strainer
 - 6. CV Flow Control for opening and closing
 - 7. ASTM A 536, B16.42, 150# Class
 - 8. Stilling well
 - 9. Acceptable Manufacturer: CLA-VAL

2.02 PIPE SYSTEMS STRAINERS

- A. Body:
 - 1. "Y" pattern or basket as shown on the drawings.
 - 2. Line size.
 - 3. Threaded strainer blow down port.
 - 4. ASTM A #126 Class B Cast Iron Body.
- B. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2".
 - 2. With 0.45 perforations in piping systems 2-1/2" and 3".
 - 3. With 0.125 perforations in piping systems 4" and larger.
- D. Start-up:
 - 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 - 2. Remove after 30 days.
 - 3. Attach to piping for owners review.
- E. Acceptable Manufacturers
 - 1. Crane
 - 2. Keckley
 - 3. Zurn
 - 4. Mueller
 - 5. McAlear
 - 6. Muesco

2.03 SUCTION DIFFUSER

- A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body is to fit both the pump inlet and suction pipe size.
- B. Components:
 - 1. Inlet straightening vanes.
 - 2. Removable end cap.
 - 3. Gauge ports.
 - 4. Threaded strainer blow down port.
 - 5. Adjustable support foot.
 - 6. Removable magnetic insert.
- C. The screen shall be as specified for pipe system strainers.
- D. Provide an additional fine mesh disposable strainer for use during start up operations.
 - 1. Remove after 30 days operation and all flushing is complete.
 - 2. Attach to piping for owners review.
- E. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- F. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2".
 - 2. With 0.045 perforations in piping systems 2-1/2" and 3".
 - 3. With 0.125 perforations in piping systems 4" and larger.

2.04 VALVE SCHEDULE

- A. Hydronic Service
 - 1. Chilled Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66 w/Nib-Seal insulated Handle
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
 - 2. Heating & Condenser Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
 - 3. Check Valve:
 - a. Nibco Check Valve: T - 413 - B
 - b. Nibco Check Valve 2-1/2" and larger: F - 918 - B
 - c. Nibco Check Valve 2-1/2" and larger: W - 920 -W (Wafer)
 - d. Keystone Check 2-1/2" and larger: FIQ 810

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers,

and where shown on the drawings.

- C. Use butterfly valves and ball valves in circulating water systems, for balancing duty. Provide infinite position gear operator with memory stop.
- D. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 - 1. 1" valve for pipes 6" and larger.
 - 2. 3/4" valve for pipes smaller than 6".
 - 3. Terminate with pipe plug.
 - 4. Drain valves shall be ball valves.
- E. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- F. Provide clearance for installation of insulation and access to valves.
- G. Provide access where valves are not exposed.
- H. Provide float valves / stilling wells in cooling tower or condenser water basins for water level control. Provide stilling wells around float valve to prevent turbulence ripples or wind interference.

3.03 PIPE SYSTEMS STRAINERS

- A. Provide an additional fine mesh disposable strainer for use during start up operations.
 - 1. Remove after 30 days operation and all flushing is complete.
 - 2. Attach to piping for owners review.
- B. Provide strainer in supply piping for all coil connections.
- C. Provide strainer in condenser water piping entering chiller.

3.04 WATER SYSTEM AIR VENTS

- A. Provide manual air vents at high points and at any other air pockets of closed circulating pipe systems. Extend 3/8" hard drawn copper tubing discharge drains to nearest floor or hub drain. Provide 1/4" Ball Valve as specified.
- B. Where high point vents are not readily accessible provide additional valves at vent termination.

END OF SECTION 23 05 23

SECTION 23 05 33
HVAC PIPE HEAT TRACING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install a complete industrial, constant wattage, UL listed system of electric pipe heat tracing and controls on all make-up water piping outdoors above grade to prevent freezing. The heat tracing system shall conform to ANSI/IEEE Standard 515-1989.
- B. Protect the pipe, valves, fittings, meters and appurtenances. Apply sufficient cable and overheat thermostat to protect the entire system.

1.02 SUBMITTALS

- A. Submit shop drawings and product data as specified in Section 23 05 12
- B. Submit detailed calculations for length of heat tracing cable per foot of pipe, based on actual length of piping installed.
- C. Submit manufacturer's certified capacity charts with selections plotted thereon.
- D. Submit manufacturer's installation instructions.
- E. Submit full load ampere requirement and voltage for branch circuit.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Raychem Corporation
- B. Thermon Manufacturing Company

2.02 COMPONENTS

- A. Self-regulating heater.
 - 1. The self-regulating heater shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed itself without overheating and to be cut in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
 - 2. In order to provide energy conservation, and to prevent overheating, the heater shall have a self-regulating factor of at least 90%.
 - 3. The heater shall operate on a line voltage of 120 VAC without the use of transformers.
 - 4. The heater shall be sized according to the following. The required heater output rating is in watts per foot at 50°F (heater selection based on 1-1/2 inch fiberglass insulation on metal piping).

5. The heater shall be XL-Trace as manufactured by Raychem Corporation or XL-Econotrace as manufactured by Thermon Manufacturing Company.
6. Power connection, end seal, splice and tee kits components shall be applied in the field.
7. The system shall be controlled by an ambient sensing thermostat set at 40°F either directly or through an appropriate contactor.
8. Provide an end-of-circuit voltage indicating light

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install and start up the pipe heat tracing system in accordance with the manufacturer's Installation, Start-up and Service Instructions.
- B. Install the pipe heat tracing cable under the pipe insulation.
- C. Apply "Electrically Traced" signs to the outside of the thermal insulation.
- D. Ground fault protection of the equipment shall be provided per the 1996 National Electrical Code, Article 427-22.
- E. Provide a cast aluminum weatherproof NEMA-4 rated junction box for installation of the cable, with pilot light to indicate operation of the cable.
- F. Use only electrical components as recommended by the manufacturer.

3.02 ELECTRICAL WORK

- A. Furnish and install the wire, conduit and raceway systems required for the automatic operation of the pipe heat tracing system. Conform to the National Electrical Code.
- B. The specified wiring work includes:
 1. Wiring of control instruments between thermostat and junction boxes
 2. Installation of thermostat and junction boxes
 3. Wiring from the heat tracing cable to the junction boxes
- C. Related branch circuit power wiring from the junction box to ground fault type circuit is specified to be provided in Division 26.
- D. Provide devices and appurtenances as specified in Division 26.
- E. Identify each circuit at each terminal with a separate tag.
- F. Color code wires in accordance with IPCEA Standards.
- G. Make all joints and connections with approved mechanical connectors.

3.03 TESTING OF THE PIPE HEAT TRACING SYSTEM

- A. Test the pipe heat tracing system:
 - 1. Simulate freezing outside air conditions
 - 2. Measure the amperage draw of the heat tracing system
 - 3. Compare to the manufacturer's capacity rating of the actual system
 - 4. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be between 20 to 1000 megohms regardless of the length.
- B. Submit records of test for approval prior to substantial completion; insert in the Owner's Manual.

END OF SECTION 23 05 33

SECTION 23 05 48
VIBRATION ISOLATION

PART 1 - GENERAL

1.01 SCOPE

- A. Furnish, install, and adjust vibration isolation.

1.02 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Refer to the Section on Ductwork for flexible connections between fans and ducts.
 - 2. Refer to the Section on Equipment Supports for equipment foundation pads.

1.03 SUBMITTALS

- A. Submit product data showing type, size, load, deflection and other information required. Include clearly outlined procedures for installing and adjusting isolators.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Amber Booth
- B. Kinetics
- C. Mason
- D. Korfund
- E. VSI.
- F. Vibration Eliminator Co., Inc.
- G. Metraflex

2.02 ISOLATOR TYPES

- A. Neoprene mountings shall have a minimum static deflection of 0.35 inches (9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.
- B. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or ¼ inch (6mm) neoprene acoustical friction pad between the base plate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall

have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

- C. Restrained spring mountings shall have an SLF mounting as described in Specification B, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of ½ inch (12mm) shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment there must be an internal isolation pad in addition to the friction pad on the bottom.
- D. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inch (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification B seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- E. Hangers shall be as described in D, but they shall be pre-compressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.
- F. Vibration hangers shall be as described under Type D- Spring and Neoprene hangers above. Hangers shall be provided with weldless eye bolts top and bottom to facilitate attachment to flat duct straps.
- G. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches (350mm) provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch (25mm).
- H. Vibration isolation manufacturer shall provide steel members welded to height saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
- I. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating concrete bases. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of

the base but not less than 6 inches (150mm). The base depth need not exceed 12 inches (300mm) unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch (12mm) bars welded in place on 6 inch (150mm) centers running both ways in a layer 1-1/2 inch (40mm) above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1-inch (25mm) clearance below the base. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable.

- J. Flexible spherical expansion joints shall employ Peroxide cured EPDM in the covers, tubes and frictioning of the reinforcement. Reinforcement must be DuPont Kevlar. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. No substitutions for the DuPont Kevlar or the solid steel embedded flange rings are acceptable. Sizes 2 inch (50mm) and larger shall have two spheres reinforced with a metal ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16 inch (400mm) to 24 inch (600mm) may be single sphere. Sizes 3/4 inch (20mm) to 1-1/2 inch (40mm) may have threaded bolted flange assemblies, one sphere and cable retention. 14 inch (300mm) and smaller connectors shall be rated at 250 psi (17 BAR) up to 190°F (88°C) with a uniform drop in allowable pressure to 190 psi (13 BAR) at 250°F (121°C). 16 inch (400mm) and larger connectors are rated 180 psi (12 BAR) at 190°F (88°C) and 135 psi (9 BAR) at 250°F (121°C). Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.

High pressure joints shall be substituted for the above where operating pressures are higher than standard. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. Control rods are not desirable in seismic work. If control rods are used, they must have 1/2-inch (12mm) thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi (6.9 N/mm²) maximum on the washer area. Standard diameter bolt washers are not acceptable.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves.

- K. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3 inch (75mm) and larger shall be flanged. Smaller sizes shall have male nipples. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.
- L. Split Wall Seals consist of two bolted pipe halves with minimum 3/4-inch (20mm) thick neoprene sponge cemented to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1 inch (25mm) past either face of the wall. Where temperatures exceed 240°F (115°C), 10 lb. density fiberglass may be used in lieu of the sponge.

- M. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2 inch (12mm) thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi (3.45 N/mm²) and the design shall be balanced for equal resistance in any direction.
- N. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2 inch (12mm) thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of $\pm 1\text{-}5/8$ inch (42mm) motion, or to meet location requirements.
- O. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air Springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8 inch (3mm). Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.
- P. Restrained air spring mountings shall have an MT air spring as described in Specification O, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch (12mm) shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation.
- Q. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind forces. All directional neoprene snubber bushings shall be a minimum of 1/4 inch (6mm) thick. Steel springs shall be laterally stable and rest on 1/4 inch (6mm) thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2 inches (50mm) of insulation.
- R. Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup as described in specification B with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4 inch (6mm) movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

2.03 ISOLATOR APPLICATION

EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION
Air Handling Units		
Floor Mounted – up to 15 HP	B	1”
Floor Mounted – 20 HP and Over	B	1.5”
Suspended	D	1”
Chiller	A	0.35”
Cooling Towers	A	0.35”
Pump (Above Grade)	B & I	1.5”
Suspended Fan Coil Units	D	0.5”
Floor Mounted Fan Coil Units	A	0.35”
Condensing Units	A	0.35”
In-Line Fans	D	0.5”
Roof Mounted HVAC Units	Q	2”
Roof Mounted HVAC Equipment	Q	2”

2.04 PIPING ISOLATOR APPLICATIONS

EQUIPMENT	ISOLATOR TYPE
Floor Mounted Pumps	J
Suspended Pumps	J
Chiller Pipe Connections	J
Chiller Refrigerant Relief	K

2.05 FLEXIBLE CONNECTIONS IN PIPING AT PUMPS

- A. Provide flexible connections at suction and discharge of chilled water, and hot water pumps, piping connections on chillers and where indicated on drawings. Refer to schedule above.

2.06 PIPING

- A. Provide a floating piping system in the central plant and in all mechanical rooms.
- To create a floating pipe system, install pipe hangers at regular intervals according to the pipe hanger schedule.

2. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping and yet, to permit piping to function as a floating system.
3. Size hangers for 200% rated load.
4. Size isolators for a minimum of 1-inch static deflection.
5. Provide Type D or E spring hangers and Type B support isolators. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Stock Requirements. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of type used so that changes required during construction and installation can be made.
- B. Factory Representation. After installation, furnish factory-trained representative of the isolation manufacturer to check various isolators and report measured versus anticipated deflection on all isolators. Have the representative certify that isolators have been installed in accordance with manufacturer's recommendations and approved submittals. Provide written report to Engineer indicating compliance prior to final acceptance.

END OF SECTION 23 05 48

SECTION 23 05 93
TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Balance, adjust and test the air distribution system including the exhaust system.
- B. Balance, adjust and test the hydronic system.
- C. Verify and record the duct test results performed by the mechanical contractor.

1.02 RELATED SECTIONS

- A. COORDINATION OF TESTING AND BALANCING

1.03 PAYMENT PROCEDURES

- A. The work of this Section of the Specifications shall bid the project directly to the General Contractor.

1.04 SUBMITTALS

- A. History of the TAB organization.
- B. Agency certification.
- C. Personnel qualifications.
- D. TAB data forms.
- E. Instrumentation list.
- F. Name of the project supervising engineer.
- G. Name and address and contact person of five successfully completed projects of similar size and scope.
- H. To perform required professional services, the balancing agency shall have a minimum of one test and balance engineer certified by the Associated Air Balance Council.

1.05 TAB FIRM QUALIFICATIONS

- A. The organization performing the work shall be a Certified member in good standing of the (AABC) Associated Air Balance Council.
- B. Able to furnish evidence of having contracted for and completed not less than five systems of comparable size and type that have served their Owners satisfactorily for not less than five years.

- C. A specialist in this field and have the personnel, experience, training, skill, and the organization to perform the work.
- D. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the engineer to determine the balancing agency's performance capability.
- E. The balancing agency shall have operated for a minimum of five years under its current name.
- F. Personnel:
 - 1. The project supervisor shall be a Professional Engineer and have:
 - a. Extensive knowledge of the work involved.
 - b. At least five years of experience conducting tests of the type specified.
 - c. This test and balance engineer shall be responsible for the supervision and certification of the total work herein specified.
 - 2. All work shall be conducted under the direct supervision of the supervising engineer.
 - 3. Technicians shall be trained and experienced in the work they conduct.

1.06 WARRANTY

- A. Provide (AABC) guarantee in writing.
- B. Extended warranty.
 - 1. Include an extended warranty of 2 years after completion of test and balance work, during which time the Architect/Engineer may request a retest or resetting of any outlet or other items as listed in the test report.
 - 2. Provide technicians and instruments to assist the Architect/Engineer in making any tests he may require during this period.
 - 3. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 TAB TOLERANCES

- A. The water, outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 5% of the value scheduled on the drawings.

3.02 SITE VISITS

- A. During construction, the balancing agency shall inspect the installation of the piping systems, sheetmetal work, temperature controls, energy management system, and other component parts of the heating, ventilating, and air conditioning systems. One inspection shall take place when 60% of the ductwork is installed and another inspection shall take

place when 90% of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the architect and engineer.

- B. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction deficiencies are encountered that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of the deficiencies.
- C. Note proper piping installation, location of valves, and flow measuring instruments.
- D. Make one series of visits, phased as required by construction progress, prior to installation of the ceiling. Note proper installation of balancing dampers.
- E. Continue the site visits up to completion of project. In each succeeding report, list corrections made from previous reports.

3.03 TESTING INSTRUMENTS

- A. Submit a list of all instruments to be used for the test and balance procedures.
 - 1. Catalog sheets
 - 2. Certificate of last calibration
 - 3. Calibration within a period of six months prior to balancing
- B. Testing equipment shall be in good working order and tested for accuracy prior to start of work.

3.04 COORDINATION WITH OTHER SPECIFICATION SECTIONS

- A. Review the related ductwork shop drawings and piping shop drawings. Make recommendations concerning suitability with respect to the testing, balancing and adjusting work.
- B. Make tests to verify proper placement of the static pressure sensors for the variable air volume fan system control.
- C. In cooperation with the work specified in Building Management and Control System section, a systematic listing of the testing and verification shall be included in the final TAB report. The TAB firm shall provide a laptop computer to operate with the Building Management and Control System. Building Management and Control System shall provide all necessary software and special interface cables, as required, to communicate with the DDC system:
 - 1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of the intended control performance.
 - 2. Verify that all control devices are properly connected.
 - 3. Verify that all dampers, valves, and other controlled devices, are operated by the intended controller.
 - 4. Verify that all dampers and valves are in the position indicated by the controller

- (open, closed or modulating).
5. Verify the integrity of valves and dampers in terms of tightness of close-off and full open positions. This includes dampers in multizone units, terminal boxes and fire/smoke dampers.
 6. Observe that all valves are properly installed in piping system in relation to direction of flow and location.
 7. Observe the calibration of all controllers.
 8. Verify the proper application of all normally opened and normally closed valves.
 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
 10. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control contractor will relocate as deemed necessary by the Engineer.
 11. Verify that the sequence of operation for any control mode is in accordance with the approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.
 12. Verify the correct operation of all interlock systems and installation is per the manufacturer recommendations.
 13. Check all dampers for free operation.
 14. Verify that all controller setpoints meet the design intent.
 15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.

- D. Upon completion of the testing and balancing, submit three days prior notice that the systems are ready for a running test. A qualified representative of the test and balance organization shall be present, with a representative from the engineer's office, to field verify TAB report readings. Specific and random selections of data recorded in the certified test and balance report will be reviewed.

3.05 INSTRUMENT TEST HOLES

- A. When it is required to make holes in the field to measure temperature, static pressure or velocity in the ducts:
1. Drill holes, plug, and tape external duct insulation.
 2. Repair damaged insulation to Engineer's approval.

3.06 TESTING THE AIR DISTRIBUTION SYSTEM

- A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
1. Supply Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage. Then, compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the 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. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
- d. Outside Air: Test and adjust the outside air on applicable equipment using a Pitot-Tube traverse. If a Pitot-Tube 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°F, or use the difference between Pitot-tube traverse of the supply and return ducts.
 - e. Static Pressure: Test and record system static pressure, including the static pressure profile of each supply fan.
2. All Other Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage. Then, compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main 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. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Static Pressure: Test and record system static pressure, including the static pressure profile of each return fan.
 3. VAV Terminal Units:
 - a. Set and record volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
 - b. Identification: Identify the type, location, and size of each terminal unit. This information must be recorded on the terminal box data sheets.
 4. Diffusers, Registers and Grilles:
 - a. Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
 5. Coils (including electric coils):
 - a. Air Temperature: Once air flows are set to acceptable limits, take wet bulb (cooling coil only) and dry bulb air temperatures on the entering and leaving side of each coil. Calculate the sensible and latent (cooling coil only) capacity of the coil. Provide information in TAB report.
- B. Record preliminary air handler data, including fan RPM and static pressures across filter, fans and coils.
 - C. Perform a velocity traverse of the main supply ducts using a pitot-tube and inclined manometer to establish initial air delivery. 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, a detailed explanation of why a traverse was not made must appear on the appropriate data sheet.
 - D. Where air measuring stations are installed, use pitot tube traverse readings to verify and record the correct calibration of the stations output.

- E. Make adjustments in fan RPM and damper settings, as required, to obtain design supply air, return air, and outside air.
- F. Measure and adjust all supply and return branches to design air delivery.
- G. Measure and adjust all diffusers to design air delivery to +/- 5% of design requirements.
- H. Make a set of recordings showing final system conditions.

3.07 TESTING THE 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; that water has been flushed and is in a clean condition, and that all balancing valves (except bypass valves) are set full open. As applicable, 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 and all results shall be recorded in the TAB report:
 - 1. Record preliminary pump data.
 - a. Pump RPM.
 - b. Pump shut-off differential head.
 - c. Pump operating differential head.
 - d. Check and verify pump alignment.
 - e. Verify impeller diameter.
- B. Adjust balancing valves in the pump discharge lines to obtain design water quantity as read from the manufacturer's pump curve and from a flow meter.
- C. In variable flow systems, the water flow of the pump shall be set at the scheduled gpm, not the total of all the valves. Determine the diversity of the system and balance the individual coils with the maximum pump water quantity flowing in the system.
- D. Balance flow through:
 - 1. Chillers.
 - 2. Coils.
 - 3. Boiler.
 - 4. Pumps
 - 6. Cooling tower.
 - 7. Heat Exchanger.
- E. Use flow meters, differential pressures and temperature relationships as required.
- F. Balance by-pass lines to obtain the same pressure drop with systems on by-pass as full flow through the coil including the valve.
- G. Repeat steps, as required, to obtain a final systems balance and make a set of recordings showing final systems conditions.
- H. Pumps:
 - 1. Test and adjust pumps to meet design water flow requirements. 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. Check and verify pump alignment.

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.
- I. Coils:
1. Tolerances: Test, adjust, and balance all chilled water and hot water coils within 5% of design flow requirements.
 2. Verification: Verify the type, location, final pressure drop and water quantity (GPM) of each coil. Calculate the actual capacity of all coils. This information shall be recorded on coil data sheets.
- J. Boilers:
1. Verify that boilers 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, adjust and record water flows through water boilers.
 4. Test and record water temperature profiles of each boiler.
- K. Chillers:
1. Verify that chillers have been started by the manufacture and are in operation. Test and adjust chiller water flows to within 5% of the design requirements by using a U-TUBE manometer and setting balancing valves.
 2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
 3. Test and record temperature profiles of each chiller at design water flow.
- L. Cooling towers:
1. Verify that cooling towers have been filled and started by others and are in operation.
 2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure cooling tower fan motor is not in or above the service factor.
 3. Test and adjust water flows to balance tower cells and flows between towers.
 4. Test and record water temperature profiles of each condenser at design water flow for water and air side operation.
- M. Heat exchangers:
1. Verify that heat exchangers have been filled and started by others, and are in operation.
 2. Test and record temperature and pressure profiles of water and steam heat exchangers.

3.08 EQUIPMENT POWER READINGS

- A. Record the following information for each motor:

1. Equipment designation.
2. Manufacturer.
3. Unit model number and serial number and frame.
4. Motor nameplate horsepower; nameplate voltage; phase and full load amperes.
5. Heater coil in starter.
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
6. Motor RPM/driven equipment RPM.
7. Power reading (voltage, amperes of all legs at motor terminals).

3.09 BOILERS

- A. Check for proper operation and with operation at near design conditions, record the following:
 1. Manufacturer, model number, serial number and nameplate.
 2. If water type, water flow in GPM, entering and leaving water temperature and water pressure drop in feet.
 3. Type of fuel and heating value.
 4. Rate of fuel consumption.
 5. Capacity in MBH.
 6. Efficiency.
 7. Flue gas analysis.
 8. Motor data.
- B. Observe demonstration that all controls and safety devices are functioning properly. Record observations.

3.10 CHILLERS (Water Cooled)

- A. Balance flow of water thru each evaporator and condenser to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.
- B. Verification of safety interlocks and controls are the responsibility of the manufacturer.
- C. With each chiller operating at near design temperature and water flow conditions, measure and record the following:
 1. Manufacturer, model number, serial number and all nameplate data.
 2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 3. Condenser water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
 5. Volts and amps for each phase.
 6. Power factor.
 7. KW input.
 8. Tons of cooling.
 9. KW per ton of cooling.

- D. Reference chiller specification for additional requirements.

3.11 CHILLERS (Air Cooled)

- A. Balance flow of water through each evaporator to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.
- B. Verification of safety interlocks and controls are the responsibility of the manufacturer.
- C. With each chiller operating at near design temperature conditions, measure and record the following:
 - 1. Manufacturer, model number, serial number and all nameplate data.
 - 2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 - 3. Condenser air entering temperature, leaving temperature.
 - 4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
 - 5. Volts and amps for each phase.
 - 6. Power factor.
 - 7. KW input.
 - 8. Tons of cooling.
 - 9. KW per ton of cooling.
- D. Reference chiller specification for additional requirements.

3.12 TESTING THE VARIABLE AIR VOLUME SYSTEM

- A. All VAV boxes used are to be calibrated to produce the rated air quantity.
- B. Set and record the supply air static pressure controller to provide actual design air flow at the most resistive terminal.
- C. Measure and adjust the design air delivery at the inlet of each VAV box.
- D. Measure and record the air quantity from each VAV box at its maximum flow. Manipulate the controller to achieve maximum flow.
- E. Reset each box to yield and record minimum primary air flow.
 - 1. DDC controllers record the correction factor required to establish actual desired air quantity as designed.
 - 2. Pneumatic controllers adjust velocity controller as required to establish actual desired air quantity as designed.
- F. If the box is operating with inlet static pressure in excess of the minimum cataloged pressure specified by the manufacturer and is not producing rated air quantity, field adjust the box to produce rated air quantity. Retest until approved results are obtained.
- G. Position the VAV boxes to the proportion of maximum fan air volume to total installed box maximum volume.

- H. Set the fan to deliver the AHUs scheduled design airflow.
- I. Perform and record a total air traverse.
- J. With the system terminal boxes set for full flow or diversity, the system will be delivering the scheduled design CFM with the most restrictive box in control. Make a speed increase if either or both static and volume are low.
- K. Set the boxes to minimum and adjust the inlet vanes and or speed controllers to prevent excessive static in the system.
- L. Coordinate with the work specified in Building Management and Control System on the final location of the sensors for the static pressure controller. Locate in the supply duct far enough from the fan discharge to be truly representative of the average static pressure in the system.
- M. Modulate the fan speed on the supply fan. Adjust as required to coordinate with the static pressure sensing network.
- N. Make a set of recordings showing final system conditions including system duct static pressures and control system setpoint.

3.13 DUCT TEST

- A. Test and Balancing Contractor shall verify and record the duct test results. A copy of the duct test results, as completed, shall be submitted to the engineer for review within five days. Provide a complete report of all the duct test results in the final TAB report.

3.14 DIRECT EXPANSION EQUIPMENT

- A. With each unit operating at near design conditions, measure and record the following:
 - 1. Manufacturer, model number, serial number and all nameplate data.
 - 2. Ambient temperature, condenser discharge temperature.
 - 3. Amperage and voltage for each phase.
 - 4. Leaving and entering air temperatures.
 - 5. Suction and discharge pressures and temperatures.
 - 6. Tons of cooling.
 - 7. Verification that moisture indicator shows dry refrigerant.

3.15 COOLING TOWERS

- A. A complete CTI certified test of the cooling tower will be performed by others at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB Report. Balance the flow over and through bypass connections of the tower.

3.16 TAB REPORT

- A. The activities described in this specification shall be recorded in a report form; and four individually bound copies shall be provided to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather

conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface" which shall include a general discussion of the system and any abnormalities or problems encountered.

- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the TAB firm.
- C. Submit reports on forms approved by the engineer that will include the following data as a minimum:
 - 1. Title Page
 - a. Company Name
 - b. Company Address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Manager
 - g. Project Engineer
 - h. Project Contractor
 - i. Project Identification Number
 - 2. Summary of the TAB report data
 - 3. Index
 - 4. Instrument List
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Range
 - f. Calibration Date
 - g. What test instrument is to be used for:
 - 5. Fan Data
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Total static pressure (total external) specified and actual
 - f. Inlet pressure
 - g. Discharge pressure
 - h. Fan RPM
 - 6. Return Air/Outside Air Data
 - a. Identification/location
 - b. Design return air flow
 - c. Actual return air flow
 - d. Design outside air flow
 - e. Actual outside air flow
 - f. Return air temperature
 - g. Outside air temperature
 - h. Required mixed air temperature

- i. Actual mixed air temperature
- 7. Electric Motors
 - a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage, nameplate, actual
 - d. PM
 - e. Service Factor
 - f. Starter size, heater elements, rating
- 8. V-Belt Drive
 - a. Identification/location
 - b. Required driven RPM
 - c. Drive sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave, diameter and RPM
 - f. Center-to-center distance, maximum, minimum and actual
- 9. Duct Traverse
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air correction factor
- 10. Air Monitoring Station Data
 - a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
- 11. Air Distribution Test Sheet
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Correction factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
- 12. Pump Data
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP

- g. Actual flow rate, pressure drop, BHP
- h. Discharge pressure
- i. Suction pressure
- j. Total operating head pressure
- k. Shut off, discharge and suction pressures
- l. Shut off, total head pressure
- m. Pressure differential settings
- 13. Cooling Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Entering air WB temperature, design and actual
 - g. Leaving air DB temperature, design and actual
 - h. Leaving air WB temperature, design and actual
 - i. Water pressure flow, design and actual
 - j. Water pressure drop, design and actual
 - k. Entering water temperature, design and actual
 - l. Leaving water temperature, design and actual
 - m. Air pressure drop, design and actual
 - n. Capacity - sensible and latent
- 14. Heating Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Water pressure flow, design and actual
 - h. Water pressure drop, design and actual
 - i. Entering water temperature, design and actual
 - j. Leaving water temperature, design and actual
 - k. Air pressure drop, design and actual
 - l. Capacity
- 15. Electric Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Electrical Characteristics
 - h. Capacity
- 16. Sound Level Report
 - a. Location (Location established by the design engineer)
 - b. N C curve for eight (8) bands-equipment off
 - c. N C curve for eight (8) bands-equipment on
- 17. Vibration Test on equipment having 10 HP motors or greater in size.
 - a. Location of points:
 - 1) Fan bearing, drive end

- 2) Fan bearing, opposite end
- 3) Motor bearing, center (if applicable)
- 4) Motor bearing, drive end
- 5) Motor bearing, opposite end
- 6) Casing (bottom or top)
- 7) Casing (side)
- 8) Duct after flexible connection (discharge)
- 9) Duct after flexible connection (suction)
- b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
- c. Normally acceptable readings, velocity and acceleration
- d. Unusual conditions at time of test
- e. Vibration source (if non-complying)
- 18. Control verification indicating date performed and any abnormalities identified.
 - a. Point Location/Description
 - b. EMS Readout (Setpoint and Actual)
 - c. Actual Readout of all points
 - d. Interlocks
 - e. Safeties
 - f. Variable speed drive tracking with EMS input
 - g. Variable speed drive Bypass operation
 - h. Sequence of operation

END OF SECTION 23 05 93

SECTION 23 05 94
COORDINATION OF TESTING AND BALANCING

PART 1 - TESTING, BALANCING AND ADJUSTING

1.01 WORK INCLUDED

- A. Balancing and adjusting of the environmental systems is specified in Section 23 05 93.
- B. Coordination of the work is specified in this Section.

PART 2 - PRODUCTS / NOT USED

PART 3 - EXECUTION

3.01 COORDINATION

- A. Bring the work to a state of readiness for testing, balancing, and adjusting.
 - 1. Install air terminal devices.
 - 2. Provide specified filters in air handling equipment. Install clean filters just prior to the start of the test and balance work.
 - 3. Verify lubrication of equipment.
 - 4. Install permanent instrumentation.
 - 5. Clean piping systems and fill with clean water.
 - 6. Complete "Start-up" of equipment.
 - 7. Check rotation and alignment of rotating equipment and tension of belted drives.
 - 8. Verify ratings of overload heaters in motor starters.
 - 9. Verify that safety and operating control set points are as designed and automatic control sequences have been checked.
 - 10. Provide control diagrams and sequence of operation.
 - 11. Collect material for maintenance manuals and prepare one manual especially for use in testing and balancing.
 - 12. Verify that graphic operational data such as start/stop instructions, valve tag schedules, and piping identification schedules have been provided where needed.
 - 13. Verify that equipment and piping identification work has been completed with valve tags, schedules, and piping identification system.
 - 14. Comb out fins on extended-surface heat transfer coils where damaged.
 - 15. Clean all strainers as required.
 - 16. Remove construction strainers after water is cleaned and treated.
 - 17. Remove all temporary filters from HVAC equipment.
 - 18. Provide start-up reports listing all start-up information and manufacturer's information attached.
- B. Provide and install new pulleys and belts as required to effect the correct speed ratio. Adjustments where no belt or pulley change is required, is specified in Section 23 05 93.
- C. Verify that the systems are ready for balancing and adjusting.
- D. Submit a letter stating:
 - 1. The specified pieces of equipment have been checked, started, and adjusted by the manufacturer.

2. Other equipment has been checked and started.
 3. The systems have been operated for the specified period of time.
 4. The automatic controls system has been adjusted, calibrated, and checked, and is operating as specified.
- E. Provide the services of a technician full time at all times at the project when testing, balancing and adjusting work is being conducted.
- F. Provide instrumentation and services to take readings of the required data for the refrigerant circuits.
- G. Provide and install volume dampers required for balancing by the TAB Contractor.

3.02 START-UP OF EQUIPMENT

- A. Pre-start & Start-up equipment using the procedures as recommended by the manufacturers.
- B. Complete start-up of equipment prior to start of testing & balancing.
- C. Submit start-up procedures as outlined by the manufacturers and complete the "HVAC FAN / AIR HANDLING / START-UP REPORT FORM" to Engineer.

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END OF SECTION 23 05 94

SECTION 23 07 13
EXTERNAL DUCT INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install external insulation on supply, return, exhaust and outside air ductwork.
- B. External insulation of concealed and exposed ducts is included in this Section. Internal acoustic duct lining is specified under ductwork and not included in this Section.

1.02 RELATED WORK

- A. Division 9 - FINISHES. Painting and Color Coding.
- B. Division 23 - MECHANICAL.
 - 1. Air Handling Units. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.
 - 2. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
 - 3. Insulation. Refer to specific sections on individual insulation types.
 - 4. Refer to insulation and liner plan detail.

1.03 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship, resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
- C. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated system is not approved.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where

condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.

- F. Where existing insulated ductwork or other services are tapped, remove existing insulation back to undamaged sections and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.04 APPROVALS

- A. Submittals. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location, and the manufacturer's installation instructions for each product.
- B. Sample Application. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.01 INSULATION

- A. Glass fiber rigid duct insulation.
 - 1. Minimum density of 3 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.7 mil aluminum foil reinforced with glass yarn mesh and laminated to 40 lbs. fire-resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Schuller 814 spin-glas FSK.
 - b. Owens-Corning Type 703 board RKF.
 - c. Knauf 3 PCF FSK.
- B. Glass fiber blanket duct insulation.
 - 1. Minimum density of 1.0 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Manville R-series Microlite FSKL.
 - b. Owens-Corning ED100 RKF.
 - c. Knauf 1.0 PCF FSK.
- C. Fiberglass reinforcing cloth mesh.
 - 1. Acceptable Manufacturers
 - a. Perma Glass Mesh.

- b. Alpha Glass Mesh.
 - c. Childers Chil-Glas #10
 - d. Foster Mast a Fab
 - e. Vimasco.
- D. Mastics, sealants, coatings and adhesives.
 - 1. Acceptable Manufacturers
 - a. Childers.
 - B. Foster.
 - c. Vimasco.
- E. Fireboard Insulation
 - 1. Totally encapsulated with foil facing.
 - 2. Two hour rated fire protection.
 - 3. Zero clearance to combustible protection.
 - 4. System shall be listed and labeled by an NRTL.
 - 5. Tested per ISO 6944, Type A Duct and achieve a 2 hour rating for stability, integrity and insulation.
 - 6. Provided system is subject to the approval of the Local Authority Having Jurisdiction.
 - 7. Acceptable Manufacturers
 - a. Unifrax ON Fyrewrap Elite 1.5
 - b. Partak Insulation, Inc. Paroc Fireboard
 - c. Thermal Ceramics FireMaster 3M
 - d. Premier Refractories International, Pyroscat.
- F. Rigid Closed Cell Insulation
 - 1. Acceptable Manufacturers
 - a. Dow Trymer.
 - b. Phenolic Foam.
- G. Reinforced Foil Tape
 - 1. Acceptable Manufacturers
 - a. Venture 1525CW
 - b. 3" FSK
 - 2. Thickness 6.5 mils
 - 3. Color: silver

2.02 COATING AND ADHESIVE

- A. Coating. Provide Childers CP-38 or Foster 30-80 vapor barrier coating. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. Outdoors: Provide as insulation coating Childers Encacel X or Foster Monolar 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249.
- C. Adhesive. Provide Childers CP-82 or Foster 85-20 vapor barrier adhesive.
- D. Reinforcing Mesh. Provide 10 x 10 white glass or polyester reinforcing mesh.

2.03 OUTDOOR DUCT LAMINATED JACKETING

- A. Rubberized bitumen compound material:
 - 1. Ultraviolet resistant
 - 2. Weatherproof
 - 3. Vapor retarding jacketing
 - 4. Laminated jacketing
 - 5. Cross-laminated high strength polyethylene film
 - 6. Laminated to aluminum foil
 - 7. Minimum 60-mil thickness
- B. Acceptable Manufacturers:
 - 1. Alumaguard 60
 - 2. Flex Clad 400
 - 3. Venture Clad 1577CW

PART 3 - EXECUTION

3.01 FIRE SAFETY REQUIREMENTS

- A. Do not extend duct coverings through walls or floors required to be fire-stopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources such as electric resistance or fuel-burning heater.

3.02 CONCEALED DUCT

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing.
- B. Standing Seams. Insulate standing seams and stiffeners, which protrude through the insulation with 0.6 lb. per cubic foot density, 1-1/2" thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on twelve inch centers to prevent sagging of insulation.
- D. On circumferential joint, the 2" flange on the facing shall be stapled with 9/16" outward clinch steel staples on 2" centers, and taped with a minimum 3" wide strip of glass fabric embedded in coating. Cover all seams, joints, pin penetrations and other breaks with vapor barrier coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.
- D. On circumferential joint, the 2" flange on the facing shall be stapled with 9/16" outward clinch steel staples on 2" centers and taped using 3" wide foil tape applied with additional adhesive of Foster 85-75. Cover all seams, joints, pin penetrations and other breaks with foil tape and glue.

- E. Ductwork in mechanical rooms is considered concealed spaces.

3.03 EXPOSED DUCT INSULATION

- A. Ductwork in exposed locations is to be insulated with fiberglass rigid / semi-rigid board insulation.
 - 1. Apply fabric and mastic to provide a smooth surface for painting.
- B. Standing Seams: Insulate standing seams and stiffeners which protrude through the insulation with 0.6 lb per cubic foot density, 1-1/2 inch thick, faced insulation. As a vapor seal, use reinforcing mesh with vapor barrier coating. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork. Adhere insulation to ductwork with adhesive. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on 12 inch centers to prevent sagging of insulation.
- D. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.

3.04 OUTDOOR DUCTWORK COVERING

- A. Cover all supply and return ductwork outdoors:
 - 1. 1-1/2" thick, rigid closed cell insulation with reinforced foil facing.
- B. Install a high point in center and slope in both directions so water will not stand on horizontal surfaces.
- C. Impale the insulation over mechanical fasteners and washers.
 - 1. A minimum of 2 rows of fasteners per side on 12-inch centers.
 - 2. Seal all breaks, joints and punctures by applying a 1/8" thick vapor barrier mastic coating, embedded in open mesh reinforcing mesh.
- D. Standing S, or flanged connections shall be covered with the same thickness of insulation overlapped a minimum of 4".
- E. Apply a tack coat of Childers CP-10/11 or Foster 46-50 weather barrier mastic over the entire surface.
 - 1. While this coat is still tacky, Childers #5 glass fiber reinforcing mesh shall be smoothly applied and pressed into the mastic. The cloth shall be taut with adjacent edges overlapped a minimum of 4".
 - 2. After the first coat of mastic has taken its set, the second coat shall be applied over the cloth by palm, trowel, or spray to sufficient thickness that, when dried, the combined thickness of mastic and cloth is not less than 1/8".
 - 3. Upon completion, the openings in the cloth shall be completely sealed and the yarn shall not be visible. The completed work shall be completely smooth and present a plane surface.
 - 4. Aluminum gray or white finish as approved by the Architect.

- F. Standing water on horizontal surfaces is not approved.
- G. Apply outdoor duct laminated jacketing protection over entire insulation surface. Apply rubberized bitumen compound, applied to a cross-laminated high strength polyethylene film, laminated to aluminum foil.

3.05 KITCHEN GREASE EXHAUST DUCTWORK / KILN DUCTWORK / FUME HOOD DUCT

- A. Secure fireboard insulation to duct with impaling pins and 3" square speed clips. In addition, provide a wire mesh support system and additional sealing or support as required by the code enforcing authority. The insulation support system shall include framed access to allow the insulation to be removed and replaced without damage at the access doors in the duct system for inspection and cleaning. Coordinate location of access openings to correspond accurately. Provide stainless steel banding on 12" centers.

3.06 GENERAL INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Apply insulation on clean, dry surfaces only.
- C. Continue insulation with vapor barrier through penetrations.
- D. Neatly finish insulation at supports, protrusions and interruptions.
- E. Install insulation on clean, dry surfaces, and only after building is weatherproofed sufficiently to preclude any rainwater on insulation.
- F. Apply mastic over the fiberglass reinforcing mesh to a thickness where fabric is not visible after completion.
- G. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

END OF SECTION 23 07 13

SECTION 23 07 15
EQUIPMENT SCREENS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pre-formed thermoplastic panel for enclosing roof top mechanical equipment.
 - 2. Aluminum assembly framing for direct attachment of screening panels to mechanical equipment; no base or curb required unless shown otherwise on drawings.
 - 3. Aluminum extrusions to permit easy access to mechanical equipment for servicing.
 - 4. Touch-up painting required for scratches and screw heads.
 - 5. Field painting of prime painted screens.

1.02 RELATED SECTIONS

- A. Section 23 81 24 - Roof Top Units.

1.03 REFERENCES

- A. American Society for Testing and Materials: Standard Specifications for
 - 1. ASTM B 221-96 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.
- B. The Aluminum Association, Inc.
 - 1. AA ADM-1516166 (1994) - Aluminum Design Manual
- C. American Society of Civil Engineers.
 - 1. ASCE 7-95 - Minimum Design Loads for Buildings and Other Structures.

1.04 SYSTEM DESCRIPTION

- A. Design Criteria:
 - 1. Manufacturer is responsible for the structural design of all materials, assembly and attachments to resist snow, wind, suction and uplift loading at any point without damage or permanent set.
 - 2. Framing shall be designed in accordance with the Aluminum Design Manual to resist the following loading:
 - a. ASCE 7-95 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog data, detail sheets, specification and other data sufficient to indicate compliance with these specifications.
- B. Shop Drawings: Indicate layouts heights, component connection details, and details of interface with adjacent construction. Mark data to indicate:

1. Roof top mechanical equipment to be enclosed.
- C. Samples:
 1. Samples of Materials: Thermoplastic panels.
 2. Color Selection: Submit paint chips with full range of colors (minimum of eight) available for Architect's selection.
- D. Certification: Manufacturer's Certificate of Compliance certifying that thermoplastic panels supplied meet or exceed requirements specified.
- E. Closeout Submittals: Warranty documents, issued and executed by manufacturer, countersigned by Contractor.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of building authorities having jurisdiction in Project location.
- B. Manufacturer Qualifications: Minimum five (5) years documented experience producing systems specified in this section.
- C. Pre-Installation Meeting:
 1. Convene at job site seven (7) calendar days prior to scheduled beginning of construction activities of this section to review requirements of this section.
 2. Require attendance by representatives of the installing subcontractor, (who will represent the system manufacturer) and other entities directly affecting, or affected by, construction activities of this section.
 3. Notify Architect four (4) calendar days in advance of scheduled meeting date.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- B. Storage and Handling: Protect materials and finishes during handling and installation to prevent damage.

1.08 PROJECT CONDITIONS

- A. Field Measurements: Take measurements of actual Roof top unit for fit without gaps. Indicate measurements on shop drawings fully documenting any field condition that may interfere with the screen system installation.

1.09 COORDINATION

- A. Installer for work under this Section shall be responsible for coordination of panel and framing sizes and required options with the Contractor's requirements.
 1. Request information on sizes and options required from the Contractor.
- B. Submit shop drawings to the Contractor and obtain written approval of shop drawing from

the Contractor prior to fabrication.

1.10 WARRANTY

- A. If any part of the rooftop equipment screen fails because of a manufacturing defect within one year from the date of substantial completion, the manufacturer will furnish without charge the required replacement part(s). Any local transportation, related service labor or diagnostic call charges are not included.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Products: “Envisor Screening System” by CityScapes Incorporated, 4200 Lyman ct. Hilliard, OH 43026. 1-877-727-3367 www.cityscaesinc.com
- B. Substitutions: Unistrut Component Materials

2.02 MATERIALS

- A. Thermoformed plastic panels: fabricated from rigid medium impact thermo-formed ABS (Acrylic Butylene Styrene) sheets.
 - 1. Minimum thickness 3/16”
- B. Framing: Aluminum Plate, Shapes and Bar: ASTM B 221, alloy 6061-T5 or 6063-T5
- C. Threaded Fasteners: All screws, bolts, nut and washers shall be stainless steel.
 - 1. Corner assembly fasteners shall be #10-16 x stainless steel TEK screws. Length as required to develop full holding capacity of screw when fastened to mechanical equipment.
 - 2. Provide lock washer or other locking device at all bolted connections.

2.03 FABRICATION

- A. Provide factory-formed panel systems with continuous interlocking panel connections and indicated or necessary components. Form all components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings
 - 1. Panel Style and Height: 35” Canted
 - 2. Panel Design: Wide Rib
- B. Trim and Closures: Fabricated from 24 gauge metal, and finished with the manufacturer’s standard coating system, unless shown otherwise on drawings.
 - 1. Provide top trim as indicated: Cove
- C. Framing: Fabricate and assemble components in largest practical sizes for delivery to the site.
 - 1. Construct corner assemblies to required shape with joints tightly fitted.
 - 2. Supply components required for anchorage of framing. Fabricate anchors and related components of material and finish as required, or as specifically noted.

2.04 FINISHES

- A. Aluminum Framing: Mill
- B. Panel Coating: Manufacturer's standard coating system, factory-applied.
 - 1. Color per Architect

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Installer's Examination: Examine conditions under which construction activities of this section are to be performed.
 - 1. Submit written notification to Architect and Screen manufacturer if such conditions are unacceptable.
 - 2. Beginning erection constitutes installer's acceptance of conditions.

3.02 INSTALLATION

- A. Install units in accordance with the manufacturer's instructions and approved shop drawings. Keep perimeter lines straight, plumb, and level. Provide brackets, anchors, and accessories necessary for a complete installation.
- B. Fasten structural supports to HVAC units without damaging operation of the unit.
 - 1. Provide corner and mid-span assemblies as required by approved shop drawings so that the panels are supported uniformly.
 - 2. Fastening bottom rail using bolts to permit ease of access to HVAC units.
- C. Insert thermoplastic panels into structural supports, except where fixed attachment points are indicated. Butt thermoplastic panels to adjacent panels for uniform fit. Fasten fixed panels in accordance with the shop drawings.
- D. Metal Separation: Where aluminum materials would contact dissimilar materials, insert rubber grommets at attachment points, thus eliminating where dissimilar metals would otherwise be in contact.
- E. Do not cut or abrade finishes which cannot be restored. Return items with such finishes to shop for required alterations.

3.03 ERECTION TOLERANCES

- A. Maximum misalignment from true position: 1/4".

3.04 CLEANING AND PROTECTION

- A. Remove all protective masking from material immediately after installation.
- B. Protection:
 - 1. Ensure that finishes and structure of installed systems are not damaged by

- subsequent construction activities.
- 2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations; provide replacement components if repaired finishes are unacceptable to Architect.
- C. Prior to Substantial Completion: Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.
 - 1. Clean units in accordance with the manufacturer's instructions.

END OF SECTION 23 07 15

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including chilled water, hot water, condenser water, refrigerant lines, condensate piping and make-up water.

1.02 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.03 SUBMITTALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each

product.

- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.04 RELATED WORK

- A. Finishes. Painting and color-coding
- B. Pipe Heat Tracing

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
 - 1. Johns-Manville Micro-Lok AP-T
 - 2. Owens-Corning ASJ/SSL
 - 3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
 - 1. Pittsburg Corning
 - 2. Cell-U-Foam
- C. Rigid Foam Insulation:
 - 1. Kingsapan Tarec
 - 2. Dow Trymer
 - 3. Tarec Ecophen – Phenolic Foam
- D. Aluminum Jacketing:
 - 1. ITW Lock-on (Childers)
 - 2. ITW Z-lock (Pabco)
- E. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Foster Mast a Fab
 - 5. Vimasco
- F. Mastics, Sealants, Coatings and Adhesives
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
 - 4. Armacell 520 Adhesive
- G. Elastomeric Insulation
 - 1. Armacell
- H. Weather Resistant Coating

1. WB Armaflex Finish
2. Foster 30-64
- I. Glass fiber blanket insulation
 1. Manville R-series Microlite FSKL
 2. Owens-Corning eD75 or ED100 RKF
 3. Knauf 0.75 PCF FSK
- J. Fire Barrier Plenum Wrap Insulation
 1. Totally encapsulated with foil facing
 2. Single layer fire protection
 3. Plenum Protection System UL910
 4. Acceptable Manufacturers
 - a. FyreWrap 0.5 Plenum Insulation
 - b. 3M Fire Barrier Plenum Wrap 5A

2.02 RIGID FOAM PIPE INSULATION

- A. Polyisocyanurate pipe insulation or phenolic foam pipe insulation, with all service reinforced vapor barrier jacket having integral laminated vapor barrier.
 1. Polyisocyanurate: Thermal conductivity 0.14 @ 75°F mean (ASTM C518).
 2. Phenolic Foam: Thermal conductivity 0.13 @ 75°F mean (ASTM C 518); minimum 2.5# density.
 3. Polyisocyanurate is not to be used inside of buildings without 25/50 rating.

2.03 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
 1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.04 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than 3/4" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test.
 1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.05 CELLULAR GLASS INSULATION

- A. ASTM C552:
 1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
 2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.06 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½" aluminum bands (2) per shield.
 - 1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 - 2. Minimum thickness of foam glass insulation shall not be less than 1" thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.07 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 or Foster 85-20 adhesive.
- B. Vapor Barrier Finish:
 - 1. Indoors: Provide as insulation coating Childers CP-38 or Foster 30-80, white. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
 - 2. Outdoors: Provide as insulation coating Childers Encacel X or Foster 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249 and must be Hypalon rubber based.
 - 3. Underground: Provide Childers CP-22/24 or Foster 60-25/26 for fittings and areas. Pittwrap cannot be used.
- C. Insulation Joint Sealant. Provide Childers CP-76 or Foster 95-50 vapor barrier sealant.
- D. Metal Jacketing Sealant. Provide Childers CP-76 or Foster 95-44 metal jacketing sealant for all outdoor metal jacketing laps.
- E. Lagging Adhesive. Provide Childers CP-50AMV1 or Foster 30-36.
- F. Other products of equal quality will be acceptable only upon approval.

2.08 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.

- C. Straps and Seals. Provide ½" x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.09 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

2.10 FIRE BARRIER PLENUM WRAP

- A. High temperature insulation blanket specifically designed to provide a single layer, flexible enclosure around combustible items located within fire rated return air plenums.
- B. Use of this method is subject to approval of the Local Authority Having Jurisdiction.

PART 3 - EXECUTION

3.01 INTERIOR PIPING

- A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-38 or Foster 30-80 vapor barrier coating for chilled water piping applications.
- B. Install hanger with protective shield, on the outside of all insulation.
- C. Where domestic water pipes (1/2" & ¾" pipe sizes) are installed on trapeze type hangers, provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.
- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.
- E. Seal ends of pipe for chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
- F. Apply a smooth flood coat of white lagging adhesive Foster 30-35 or Childers CP-35 over all exposed insulation within mechanical rooms.
- G. Piping to be insulated as specified above:
 - 1. Chilled water and heating water
 - 2. Domestic hot and cold water
 - 3. Make-up water
 - 4. Horizontal sanitary drain piping that receives condensate

5. Exposed to view storm drainage system including roof and overflow drain bodies, vertical piping from drain body to elbow, all horizontal rain leaders, and first elbow turning down
6. Condenser water

3.02 REFRIGERANT AND CONDENSATE PIPING

- A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding unslit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.
- B. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Foster 85-75, Childers CP-82 or 520 Adhesive.
- C. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter.
- D. Outdoor exposed piping shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.

3.03 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using Childers CP-82 or Foster 85-20 adhesive. Secure fitting insulation covers and segments in place with 1/2" wide glass filament tape.
- D. Apply a tack coat of fitting vapor barrier coating over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
- F. Apply coating over the fiberglass cloth to a thickness where the mesh is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier coating at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- H. Finish with aluminum jacketing as specified.

3.04 UNDERGROUND PIPE COVERING

- A. Cover chilled and hot water piping underground with cellular glass insulation.

- B. Butter insulation joints with Childers CP-76 or Foster 95-50 vapor barrier sealant. Secure with stainless steel bands or 1/2" fiberglass reinforced tape on 9" centers.
- C. Cover valves and flanges with fabricated fittings of thickness and material equal to the adjoining insulation. Fasten fittings in place with stainless steel bands or 1/2" fiberglass reinforced tape.
- D. Apply a tack coat of fitting mastic Childers CP-22/24 or Foster 60-25/26 over the insulation and bands.
- E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
- F. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier mastic at all valves, fittings, flanges and every 21' on straight run piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe, making a complete seal.
- H. Finish with 125 mil thickness Pittwrap jacket applied in accordance with manufacturer's instructions. At contractor's option, cover insulation with Servi-Wrap P-500 installed in accordance with manufacturer's instructions.

3.05 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
 - 1. Apply a tack coat of insulating coating/mastic to the insulated fitting to produce a smooth surface.
 - 2. After mastic is dry, apply a second coat of vapor barrier coating/mastic. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
 - 3. Overlap coating/mastic and fiberglass/polyester reinforcing mesh by 2" on adjoining sections of pipe insulation.
 - 4. Apply a second coat of coating/mastic over the fiberglass/polyester reinforcing mesh to present a smooth surface.
 - 5. Apply coating/mastic to a wet film thickness of 3/64".
 - 6. Fabric shall not be visible after completion.
 - 7. Vapor seal flanges, valves and fittings with Childers CP-38 or Foster 30-80. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. PVC fitting covers are not acceptable.

3.06 ALUMINUM JACKETING (Insulated Piping Outdoors Above Grade)

- A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.

- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal with the application of 1/8" bead of Childers CP-76 or Foster 95-44 metal jacketing sealant.
- C. Install straps on 9" centers and at each circumferential lap joint.
- D. Cover and seal all exposed surfaces.
- E. The use of screws and rivets is not approved.
- F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.07 MISCELLANEOUS

- A. Insulate pumps.
- B. Install materials after piping has been tested and approved.
- C. Apply insulation on clean, dry surfaces only.
- D. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.08 INSULATION THICKNESS

<u>INSULATED UNIT</u>	<u>THICKNESS (Inches)</u>
Refrigerant Piping	1-1/2
Chilled Water Piping (through 2" pipe)	1-1/2
Chilled Water Piping (2-1/2" pipe and Larger)	2
Condensate Drains	1
Exterior Condenser Water Piping	2
Heating Water Piping 2" Pipe and Larger	2
Heating Water Piping 1-1/2" Pipe and Smaller	1-1/2
Exterior Chilled and Hot Water Piping, 5" Pipe and Larger	2
Exterior Chilled and Hot Water Piping 4" Pipe and Smaller	1-1/2
Underground Piping Covering, 1-1/2" Pipe and Smaller	1
Underground Pipe Covering 2" Pipe and Larger	1-1/2

END OF SECTION 23 07 19

SECTION 23 09 33
BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. Provide and install a complete Building Management and Control System (BMCS), including industrial instrumentation necessary to obtain functions and results specified. A complete system includes items such as sensors, valves, dampers, valve and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.
- B. Temperature Control System components:
 - 1. Electronic instruments as specified
 - 2. Electric instruments as specified
 - 3. Microcomputer instruments as specified
- C. All control devices of the same type product shall be of a single manufacturer.
- D. Control, power and interlock wiring necessary to accomplish sequences specified in this Section shall be provided and installed by the Control Subcontractor. Materials and methods of execution as specified in Division 26, Electrical.
 - 1. Coordinate current characteristics of all electrical instruments and equipment with Division 26 of the specifications and related electrical drawings.
- E. The entire Building Management and Control System (BMCS) shall be installed by the Automation System Manufacturer or Authorized Distributor.
 - 1. All components and elements
 - 2. The testing and acceptance procedure
- F. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- G. The entire Building Management and Control System (BMCS) shall be installed, Commissioned, and tested; all performed by the Automation System Manufacturer or Authorized Distributor if approved by engineer.
 - 1. All components and elements.
 - 2. Start-up and point verification.
 - 3. The testing and acceptance procedure.
- H. The cost of the work specified in this section is included in an allowance.
 - 1. Selection of subcontractor will be determined at a future date.

1.02 RELATED WORK

- A. Division 23, Mechanical

B. Division 26, Electrical

1.03 SUBMITTALS

- A. Submit items of the Building Management and Control System (BMCS).
 - 1. Temperature control equipment & Field devices.
 - 2. Wiring & Flow diagrams.
 - 3. Sequence of operation.
 - 4. Complete, detailed, control and interlock-wiring diagram.
 - 5. Indicate mechanical and electrical equipment furnished and electrical interlocks, indicating terminal designation of equipment. Respective equipment manufacturers shall furnish through the Mechanical Contractor, approved drawings of equipment to be incorporated in this diagram.
 - 6. Submit Input / Output summary of all points.
 - 7. Submit an outline of testing procedures from section Testing and Acceptance.
 - 8. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply", "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
 - 9. Submit sample of space temperature sensor and guards for review prior to purchase or installation.

1.04 COOPERATION WITH OTHER TRADES

- A. Furnish control valves, temperature sensing element wells, flow and pressure sensing devices, dampers and other similar devices to the Mechanical Contractor in a timely manner for installation under the Building Management and Control System (BMCS), Subcontractor's supervision.

1.05 WARRANTY

- A. Provide with a manufacturer's parts and labor warranty for a period of two years from substantial completion.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Automated Logic Branch Office - WebCTRL
- B. Siemens Building Technologies - APOGEE
- C. Delta by Team Solutions
- D. Reliable by Unify Energy Solutions

2.02 SYSTEM ARCHITECTURE

- A. The Building Management and Control System (BMCS) shall consist of an information-sharing network of stand-alone Direct Digital Control Panels (DDCP) to monitor and control equipment as specified of the control sequence and input/output summary.

- B. "Information sharing" shall be defined as: The function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways or central computers.
- C. "Stand-alone" shall be defined as: The function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

2.03 COMMUNICATIONS PROCESSING

- A. The BMCS shall operate as a true token-pass peer-to-peer communication network. Resident processors in each DDCP shall provide for full exchange of system data between other DDCP's on the network trunk. Systems that limit data exchange to a defined number of system points are not acceptable.
- B. Systems that operate via polled response or other types of protocols that rely on a central processor or similar device to manage DDCP to DDCP communications may be considered only if a similar device is provided as a stand-by. Upon a failure of malfunction of the primary device, the stand-by shall automatically, without any operator intervention, assume all BMCS network management activities.
- C. The failure of any DDCP on the network shall not affect the operation of other DDCP's. All DDCP failure shall be annunciated at the specified alarm printers and terminals.
- D. Network shall support a minimum communications speed of 115.2 Kbps.
- E. The network shall support a minimum of 100 DDC controllers and PC workstations.
- F. Each PC workstation shall support a minimum of 4 peer-to-peer networks, either by hardwired connection or dial up.
- G. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points. Provide examples of 5 reference projects utilizing gateways required for this project.

2.04 DDCP HARDWARE

- A. Each DDCP shall consist of a 32-bit microprocessor and controller, power supply, input / output boards and communication board. All program and point databases shall be stored in battery-backed RAM. Provide a minimum of 1.2 MEG RAM in each DDCP to allow for point expansion and trend data storage.
- B. Each DDCP shall incorporate a real-time clock.
- C. Each DDCP shall be provided with two RS232 communications port. Connecting an operator terminal, whether portable or stationery, shall allow the user to communicate with the entire network.
- D. Each DDCP shall provide for input / output connections to field equipment. The following point types shall be supported:

1. Analog inputs - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
 2. Analog outputs - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pressure signals. Pneumatic outputs shall be provided with a manual override for adjusting outputs in the event of a power loss at the DDCP.
 3. Digital inputs - for monitoring dry contacts such as relays, switches, pulses, etc.
 4. Digital outputs - to control two position devices such as starters, actuators, relays, etc.
- E. Each DDCP shall be listed under UL916 (Energy Management Systems), and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.
- F. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:
1. Control processes
 2. Energy management applications
 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 4. Historical/trend data for points specified
 5. Maintenance support applications
 6. Custom processes
 7. Operator I/O
 8. Dial-up communications
 9. Manual override monitoring
- G. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
 2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
- H. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
 2. Should DDC Controller memory be lost for any reason, the user shall have the

capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

3. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2.05 PROGRAMMING FUNCTIONS

- A. Resident software in each DDCP shall provide custom programming of control strategies.
 1. Point database
 2. Operator interface
 3. Network communications
 4. Facilities and energy management functions
- B. Programming of control and energy management strategies shall be accomplished via a high-level computer language such as BASIC, JC BASIC, C, or Powers Process Control Language. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral and derivative control.
- C. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command and edit the BMCS via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

2.06 FACILITY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with standard and custom report generation functions that include:
 1. Alarm summaries
 2. Motor status summaries
 3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
 4. Program listings
- B. All reports shall be either displayed or printed by:
 1. Operator request.
 2. Time of day.
 3. Event conditions (such as in response to an alarm, interlock, etc.).
- C. All reports shall be time and date stamped.
- D. An alarm-processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed or printed at designated terminals.
- E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection: Either by a pre-defined time interval sample or upon a pre-defined change of value. Trend data shall be presented in a columnar format. Each sample shall be timed stamped.

Trend reports may be a single point or may be a group of points, up to a maximum of (8) points in any single group. Any point, regardless of physical location in the system may become part of a multiple point group.

- F. Each BMCS network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.
- G. A database and configuration report program shall be provided that allows the user to interrogate BMCS status. As a minimum, the user shall be able to: Verify available RAM at each DDCP, verify DDCP status (on-line, off-line, and failed) and set the system clock.
- H. Any invalid operator entry shall result in an error message.
- I. DDCP's shall contain a password access routine that will assign an operator to one of three level of access. Level 1 shall permit display function only, level 2 shall additionally permit commanding of system points and level 3 shall additionally permit full program and database editing.
- J. DDCP's shall provide for the accumulation of totalized values for the purposes of run-time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.

2.07 ENERGY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with an optimal start program such that the building may be divided into ten zones for optimum start. Warm-up and cool-down shall occur in sequence with succeeding zones starting only after the preceding zone has completed its warm-up or cool-down.
 - 1. The optimum start-up time of assigned equipment shall be determined based on a software calculation that takes into consideration outdoor air conditions, space conditions, and building thermal characteristics ("U" factor).
 - 2. The optimum start program shall control start-up of the cooling and heating equipment to achieve the target occupancy space temperature at the precise time of building occupancy.
 - 3. A built-In "learning" technique shall cause the BMCS to automatically adjust itself to the most affective time to start equipment based on historical data.
- B. The BMCS shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user in English language to specify month, year, day and time and associated point commands. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time delays shall be provided to "stagger" on times.
 - 1. TOD shall incorporate a holiday and special day schedule capability, which will automatically bring up a pre-defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance.
 - 2. In addition to the time dependent two-state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops controlled by the BMCS. As with the two-state control, time dependent setpoint

- control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal.
3. The operator shall be capable of reading and/or altering all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation.
 4. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule.
 5. The TOD program shall interface with the optimal start program (OSP) such that stop times may be assigned by OSP.
- C. Additional Program functions required are to be installed and programmed as requested by end user at no additional cost:
1. Enthalpy optimization.
 2. Supply air reset.
 3. Hot water reset.
 4. Chilled water reset.
 5. Volumetric control.
 6. Dead band control. Install dual set points as requested by user.
 7. All specified energy management programs, whether or not applicable to this project shall be provided such that the owner may enable the program at a future date without the need to purchase additional software or modify existing software.

2.08 WEB SERVER ACCESSIBILITY

- A. Industry leading encryption technology to provide accessibility through a web browser.
- B. Building Manager's ability to access, view and command critical building information in real time over the intranet or internet.
1. Alarm Display
 2. Point Commanding
 3. Graphic Display
 4. Scheduling
 5. Running Reports
 6. Point Details

2.09 REMOTE NOTIFICATION

- A. Remote notification sends Alarm and System Event information to various notification devices as indicated below but not limited to. Operators can receive their building automation system alarms without restricting them to dedicated workstations.
1. Alphanumeric pagers
 2. Numeric pagers
 3. Email
 4. Phones via voice or short message service (SMS)

2.10 POINT EXPANSION MODULES

- A. Capable of extending its input/output capabilities via special purpose modules.

1. Modules may be mounted remote from the DDCP.
2. Shall communicate with the DDCP over a pair of twisted cables.

2.11 TERMINAL EQUIPMENT CONTROLLERS

- A. Provide for control of each piece of equipment, including, but not limited to, the following:
 1. Variable Air Volume (VAV) boxes
 2. Constant Air Volume (CAV) boxes
 3. Dual Duct Terminal Boxes
 4. Unit Conditioners
 5. Heat Pumps
 6. Unit Ventilators
 7. Room Pressurization
 8. Fan Coil Units
- B. Include the following items:
 1. All input and outputs necessary to perform the specified control sequences.
 - a. Analog outputs shall be industry standard signals such as 24V floating control.
 2. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
 3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.
 4. Return to full normal operation without user intervention after a power outage of unlimited duration.
 5. Operation programs shall be field selectable for specific applications.
 6. Specific control strategy requirements, allowing for additional system flexibility.
 7. Controllers that require factory changes of all applications are not acceptable.

2.12 ELECTRONIC DAMPER ACTUATORS

- A. Two position damper operators:
 1. Spring return to full travel position.
 2. Built in auxiliary switches (motor end switches)
 - a. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
 3. Minimum torque 60-in-lb
- B. Modulating damper operators:
 1. Sized with sufficient reserve power to provide smooth modulating action and tight close off against the system pressure
 2. Select the operator with available torque to exceed the maximum required operating torque by not less than 100%
 3. Minimum torque 100 in-lb

2.13 ETHERNET CARD

- A. Ethernet Card:
 1. Local area network connection interface card.

2.14 CONTROL CABINETS

- A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors.
 - 1. Powder coat painted on all sides
 - 2. Cabinet with continuously piano type hinged door
 - 3. Locking latch
 - 4. All locks shall use a common key
 - 5. Devices on the panel face must be identified with engraved nameplates.
 - 6. Panels or termination panels must be identified with engraved nameplates.
 - 7. Provide enamel beige finish and extruded aluminum alloy frame UL 50 certified.

2.15 REFRIGERANT MONITOR (USE IN CENTRAL PLANT APPLICATIONS)

- A. Infrared Halogen Gas monitoring system for low level continuous monitoring of numerous CFC, HFC and HCFC halogen gases used in most refrigeration and air conditioning systems.
- B. Two years parts and labor warranty.
- C. Analyzer:
 - 1. Microprocessor based
 - 2. Infrared (IR) sensor technology
 - 3. Sensing down to 1 (PPM)
 - 4. Monitor multiple compounds
 - 5. Automatic calibration
 - 6. Synchronous 2 wave length infrared filterometer
 - 7. Insensitive to vibration and temperature variations.
 - 8. Response Time: Min.5 sec / Max. 90 sec.
 - 9. Sampling Mode in Auto and Manual operation
- D. Multi-Point Sampling System:
 - 1. Minimum of six sample points
 - 2. Adjustable sampling time, with optional skip and hold features for each point.
 - 3. Sample lines up to 500' in length
 - 4. Three stage alarms for each point
 - 5. Flow loss and malfunction indicators
 - 6. Individual relay contacts for each set of channel alarms.
 - 7. Infrared detection
- E. Alarming and Display:
 - 1. Digital display in PPM/PERCENTAGE
 - 2. Provide a 0-10V and 4-20mA output for direct input into the Building Management System or Direct Digital Control System.
 - 3. Adjustable three level alarm for each point shall and be supplied with common alarm output contacts.
 - 4. Provide local digital indication of PPM level for each sample point.
 - 5. Loss of any sample flow
 - 6. Identify alarm point by flashing display and actual PPM.
 - 7. Automatic zero mechanism and malfunction indicators.
 - 8. Silence audible alarm switch with re-activation after adjustable time delay.

- F. Power requirement:
 - 1. 120 VAC
- G. Audible sound pressure level of at least 15Dba above the operating ambient noise level within machine room and providing a distinctive strobe type visual alarm both inside and out side machine room at each entrance. Ceiling mounted rotating beacon in center of machine room. Strobes shall be provided immediately adjacent to and outside of each refrigeration machinery room exit. A clearly identified switch of the break-glass type shall be provided immediately adjacent to and outside of each refrigeration machinery room exit.
- H. Acceptable manufacturers:
 - 1. General Analysis Corporation
 - 2. Yokogawa Corporation
 - 3. MSA
 - 4. Sherlock
 - 5. Vulcain

2.16 AUTOMATIC CONTROL VALVES

- A. Pressure ratings: Minimum 125 psig or 1.25 times maximum system operating pressure.
- B. Construction:
 - 1. 2" and smaller:
 - a. Screwed.
 - b. Bodies and internal parts: Bronze, stainless steel or other approved corrosion-resistant metal.
 - 2. 2-1/2" and larger:
 - a. Flanged.
 - b. Bodies: Cast iron or cast steel.
 - c. Seats and parts exposed to fluid: Bronze, stainless steel or other approved corrosion-resistant metal.
 - 3. Characterized port ball valves are acceptable for VAV terminal units only.
- C. Modulating straight through water valves: Equal percentage contoured throttling plugs.
- D. Three Way Mixing Valves: Linear throttling plugs allowing total flow through valve to remain constant regardless of position.
- E. Sizes: By Automatic Control System Manufacturer for fully modulating operation.
 - 1. Minimum pressure drop: Equal to pressure drop of coil or exchanger.
 - 2. Maximum pressure drop: 5.5 psi.
 - 3. Relief and bypass valves: Sized according to pressure available.
 - 4. 2-position valves: Line size.
 - 5. Manual by-pass operator.
- F. Electronic Actuator:
 - 1. Direct coupled installation
 - 2. Visual and electronic stroke indicator
 - 3. Die-cast aluminum housing
 - 4. Manual override

5. Self-lubricating bearing and gear train
6. Automatic calibration
7. Automatic duty cycle protection
8. Overload and stall protection
9. Non-spring return
10. Floating /0-10 VAC / 4-20mA operation
11. UL approved
12. Provide smooth modulating action and tight close off against the system pressure.
13. Torque to exceed the maximum required operating torque by not less than 150%.
14. Actuator input signal shall be compatible with output DDC controller.
15. Provide weatherproof enclosure (exterior use).
16. Damper actuators not acceptable for valves.

G. Cooling Tower By-Pass and Chiller / Cooling Tower Isolation Valves & Actuators:

1. Valve Bray (Series 31 or NYL)
 - a. Line Size Valve
 - b. Under-cut disk for smooth operation
 - c. Full Lug Valve
 - d. Cast Iron Body
 - e. EPDM - Seat
 - f. 416 Stainless Steel Stem
 - g. Nylon Coated Ductile Iron Disc
 - h. Disc-to-stem connection shall utilize a double "D" or key design requiring no screws or pins to connect stem to disc.
2. Electronic Actuator: Bray (Series 70)
 - a. Fully configurable without need for software or handheld settings device
 - b. Direct Mount
 - c. Solid state speed control
 - d. Visual and electronic stroke indicator.
 - e. Anti-Condensation Heater (exterior actuators)
 - f. Die-cast aluminum housing.
 - g. Manual override by means of hand wheel
 - h. Self-lubricating bearing and gear train.
 - i. All steel self-locking output gearing to be provided
 - j. Continuous Duty Rated Motor
 - k. Overload and stall protection.
 - l. Floating /0-10 VAC / 4-20mA operation.
 - m. Mechanical Travel stops
 - n. UL approved.
 - o. Smooth modulating action.
 - p. Tight close off against the system pressure.
 - q. Sized to exceed 150% of the maximum required operating torque of the valve while under the maximum rated shut-off pressure
 - r. Actuator input signal shall be compatible with output DDC controller.
 - s. Provide weatherproof enclosure
 - t. Damper actuators not acceptable for valves.

H. Variable Primary Flow By-Pass Control Valve:

1. Modulating straight through control valve with equal percentage contoured throttling plug and electronic operator.
2. Maximum pressure drop: 10 psi

3. Sized for minimum flow of one chiller
4. Torque to exceed the maximum required operating torque by not less than 150%.

2.17 FLOW SWITCHES

- A. Wetter parts made of type 316 stainless steel.
 1. Designed for mounting in pipe tee.
 2. Watertight, dust-tight, and corrosion resistant enclosure.
 3. Paddle shall be factory fabricated to accommodate pipe sizes used.
 4. Switching action shall be single pole double throw.
- B. Approved manufacturer:
 1. ITT McDonald Miller #FS7-4WL for piping over 8", FS7-4W for chilled water.
 2. ITT McDonald Miller #FS7-4L for piping over 8", FS7-4 for hot and condenser water.
- C. Remote Flow Solid-State Flow Detection:
 1. Extended length flow probe
 2. Cabinet-mounted control monitor
 3. Wetted parts, 316 stainless steel probe
 4. Optional temperature and wire-break outputs
 5. Flow and temperature switch points
 6. LED bar graph display for status indication
- B. Approved Manufacturer:
 1. IFM Effector

2.18 DIFFERENTIAL PRESSURE SWITCHES

- A. Wet/wet differential pressure switch
 1. Integral Mounting Frame
 2. Watertight, dust-tight, and corrosion resistant enclosure.
 3. Wetted materials of brass and fluoroelastomer.
 4. Externally adjustable set point
- B. Approved manufacturer:
 1. Square D #9012GGW4
 2. Dwyer #DXW-11-153-1
 3. Carrier #HK06ZC033

2.19 TEMPERATURE LOW LIMIT SWITCH

- A. Responsive to the coldest 1' section of its length.
 1. Double pole single throw switch
 2. 20' capillary
 3. Line voltage with bellows actuated switch
 4. Auto reset for outdoor installation
 5. Manual reset for indoor installation

2.20 TEMPERATURE AND HUMIDITY SENSORS

- A. Space Temperature Sensors
 - 1. Thermister with resistance of 10,000 ohms at 77°F.
 - 2. Accuracy shall be $\pm 1/2^\circ\text{F}$.
 - 3. Range of 55° to 95° F.
 - 4. Surface Mounted (edit for each project)
 - a. Digital temperature display (edit for each project)
 - b. Setpoint slide adjustment (edit for each project)
 - c. Override button (edit for each project)
 - d. Color to be approved by Architect / Owner, submit sample for review
 - 5. Flush mounted (edit for each project)
 - a. Stainless steel flush mount sensor, submit sample for review.
 - 6. Location and height to be approved by Architect/Engineer prior to installation.
 - 7. Provide metal guards in the following locations: (edit for each project)
 - a. Corridors
 - b. Cafeteria
 - c. Kitchen
 - d. Gymnasium
 - e. Dressing Rooms
 - f. Industrial Labs
- B. Space / Duct Humidity Sensor
 - 1. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
 - 2. Capacitance element shall be field replaceable and not require calibration.
 - 3. Accuracy shall be $\pm 2\%$ in the range from 20 to 95% RH.
 - 4. Relative humidity sensors shall have the sensing element of inorganic resistance media.
 - 5. Provide locking metal covers suitable for institutional use. Submit sample for review. (edit for each project)
 - 6. Provide manufacturers calibration certificate.
 - 7. Provide metal guards in the following locations: (edit for each project)
 - a. Corridors
 - b. Cafeteria
 - c. Kitchen.
 - d. Gymnasium.
 - e. Dressing Rooms.
 - f. Industrial Labs.
- C. Duct Temperature Sensors
 - 1. Range of 20° to 120°F.
 - 2. Single point sensing of temperature.
 - 3. Averaging elements of sufficient length to sense temperature across 2/3 duct width.
 - 4. Averaging elements of sufficient length to provide accurate, representative indication and control.
 - 5. Averaging elements of sufficient length to prevent variances in temperature or stratification.
- D. Liquid Immersion Temperature Sensors
 - 1. Platinum type resistance temperature detector (RTD).
 - 2. Match sensor range to medium being monitored.

- a. Hot water range 30° to 250°F.
 - b. Chilled Water 20° to 70°F.
 3. Furnish stainless steel wells for installation by Mechanical Contractor.
 4. Locate all sensors in field with Owner/Engineer present.
 5. System accuracy for liquid temperature sensing shall be $\pm 1/2^\circ$.
 6. Sensors must be removable from wells.
- E. Outside Air / Freezer / Cooler Sensors
1. Range of -58° to 122°F .
 2. Weatherproof sun shield.
 3. External trim material corrosion resistant with all parts assembled into water tight, vibration-proof, heat resistant assembly.
 4. Minimum of 8' long leads.
 5. Encapsulated into Type 304 stainless steel tubes with low conductivity moisture proofing material and lag extension for thickness of insulation.

2.21 CURRENT SENSITIVE RELAYS

- A. Ensure compatibility with VFD applications for variable speed motor status.
1. Provide with adjustable set point.
 2. Relays must be mounted and not hung by power wires thru CT.
 3. Provide split-core type current sensors.
 4. Loop powered.
 5. LED Status.
 6. Acceptable Manufacturer: Veris Industries / Hawkeye
 7. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored.

2.22 DIFFERENTIAL PRESSURE TRANSDUCER

- A. Transducers to convert differential pressures to 4-20 MA analog outputs.
1. Solid state pressure sensor with accuracy of $\pm 1\%$ of calibration range.
 2. Factory calibrated and have zero and span trimmers for field calibration.
 3. Range shall be selected to match the medium being monitored.
 4. Pressure snubbers to protect from pressure pulses and a 3-way bypass / valve assembly to protect the transducer from overpressure damage during start-up.
 5. LCD Display
 6. Acceptable Manufacturer: Rosemount 1151 or 3051 Pressure Transmitter

2.23 FLOW DIFFERENTIAL PRESSURE SWITCH (**EDIT FOR SPECIAL APPLICATIONS**)

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system differential pressure.
1. Select the pressure range based on the sensed differential pressure.
 2. The unit shall be protected against overpressure to the full static pressure rating.
 3. Accuracy: $\pm 2\%$ of full scale.
- B. Switch assembly.
1. Reed switch.
 2. NEMA-4 enclosure.
 3. Threaded boss conduit entrance.

4. SPST action.
 5. Voltage and rating as required for the control circuit.
- C. Wetted parts shall be made of type 303 stainless steel.
- D. Install an isolation valve in each sensing pipe leg to permit servicing without shutting the system down.

2.24 ELECTRIC REMOTE BULB THERMOSTAT

- A. Two position remote bulb thermostat:
1. Bimetal controlled.
 2. Sealed mercury switches.
 3. Provide specified control action.
 4. Adjustment can be made by removing unit cover.
 5. Element with capillary length as required for the location.

2.25 ELECTRIC SPACE THERMOSTAT

- A. Two position space thermostat.
1. Single Pole switch actuated by bi-metal sensing element.
 2. Range shall be 60°F to 90°F.
 3. Removable external knob adjustment means.

2.26 HIGH STATIC PRESSURE SWITCH

- A. With manual reset switch
1. Approved manufacturer: Cleveland AFS-460.

2.27 INSERTION FLOW SENSORS

- A. Turbine Flow Meter
1. Retractable hot tap flow sensor
 2. Accuracy: +/- 1% of full scale
 3. Dual Turbine
 4. Custom thread-o-let 400 psi / 250°F rated
 5. Line size from 2-1/2 to 72 inch
 6. Metering range from 0.3 to 15 f/sec.
 7. Remote NEMA 4 wall mounted LCD display
 8. Field Pro Software & Communicator
 9. Warranty two years
 10. Approved Manufacturer: Onicon Flow Meter F1200 Series
- B. Electromagnetic Flow Meter
1. Retractable hot tap flow sensor
 2. Accuracy: +/- 1% of full scale
 3. Electromagnetic
 4. Custom thread-o-let 400 psi / 250 degree F rated.
 5. Line size from 1-1/4 to 72 inch
 6. Metering range from 0.3 to 15 f/sec.
 7. Remote NEMA 4 wall mounted LCD display

8. Field Pro Software & Communicator
9. Warranty two years
10. Approved Manufacturer Onicon Flow Meter F3500

2.28 CONTROL DAMPERS

- A. Opposed blade dampers.
 1. Frames of 13-gauge galvanized sheet metal.
 2. Provisions for duct mounting.
 3. Damper blades not exceeding 8" in width.
 4. Blades of two sheets of 16-gauge galvanized sheet metal.
 5. Blades suitable for high velocity performance.
 6. Bearings of nylon or oil-impregnated, sintered bronze.
 7. Shafts of 1/2" zinc-plated steel
 8. Leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure.
 9. Replaceable resilient seals along top, bottom and sides of frame and blade edge.
 10. Submit leakage and flow characteristics data with shop drawings.
 11. Linkage shall be concealed out of the air stream within damper frame.
 12. Acceptable Model is Ruskin Model CD60.

2.29 PHOTO CELL CONTROL

- A. Light Sensitive Resistor.
 1. 4-20 output or switch.
 2. On = 3.0 / fc. Off 10.0 / fc.
 3. UL Approved.

2.30 DRAIN PAN FLOAT SWITCH

- A. Rated at 10 Amps.
 1. Shuts off equipment if water level becomes too high.
 2. DPDT Contacts.

2.31 BY-PASS AUTOMATIC SHUT-OFF TIMERS

- A. Rated at 10 Amps, 125 VAC
 1. Shuts off equipment with timed switch
 2. White decorated timer
 3. Without hold feature
 4. Time Cycle 60 minutes

2.32 CO₂ SENSOR

- A. Telaire Model T5100 CO₂/Temperature Sensor or approved equal
 1. Local visual indication of CO₂ levels in enclosed spaces.
 2. Pre-calibrated with factory default settings of 1000 ppm and 1500 ppm CO₂ levels
 3. Bright LED indicator transitions between green, yellow, and red as the CO₂ threshold is exceeded.
 - a. Accuracy: +/- 30 ppm @ 72°F
 - b. Output: 0-10 V (100Ω output impedance) and NTC 20k Thermister

2.33 AIR FLOW SENSING SWITCH

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system positive, negative, or differential pressure.
 - 1. Select the pressure range based on the sensed differential pressure.
 - 2. The unit shall be protected against overpressure to the full static pressure rating.
 - 3. Accuracy: +/- 2% of full scale
- B. Switch assembly:
 - 1. Reed switch
 - 2. Field adjustable setpoint
 - 3. Threaded boss conduit entrance
 - 4. SPST Action
 - 5. Voltage and rating as required for the control circuit

2.34 LCD TOUCH-SCREEN DISPLAY (EDUCATIONAL KIOSK)

- A. Wall mounted, large screen 42" LCD touch screen monitor.
- B. Steel enclosure for durability in high traffic applications.
- C. Touch-screen sensor technology.
- D. High performance and optic definition.

2.35 SERVER/CPU (EDUCATIONAL KIOSK)

- A. Minimum performance characteristics:
 - 1. 1.8 GHz AMD Mobile Turion 64 X2 Processor.
 - 2. 2.0 GB RAM.
 - 3. 500 GB 2.5" Hard Drive.
 - 4. Windows 7 32 bit operating system.
 - 5. PS/2 Mouse and Keyboard.

2.36 HVAC SHUTDOWN STATION

- A. Lockdown Switch:
 - 1. Mushroom Red Button within a clear plastic cover
 - 2. Latches when depressed
 - 3. Twist reset
 - 4. Sign "HVAC SHUTDOWN"
 - 5. Manufactured by STI Model #SS2031HV-EN

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The control system shall be installed and final adjustments made by full-time employees

of the factory-approved BMCS Building Management Control Subcontractor.

- B. The contractor shall collaborate through Architect / Engineer and Owner to determine the Owner's preference for naming conventions, etc. before entering the data in to the system.
- C. Due to actual operational or space conditions, it may be necessary for the Contractor to make sequence of operation modifications and/or controller adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each room or space. These change, if requested by the Owner or Engineer, shall be performed at no additional cost to the Owner. Therefore labor allowances should be made for such changes and adjustments if requested.
- D. Points listed within this section are to be connected to the BMCS system as hard-wired points to cards and not connected through BacNet integration. The BacNet interface is for read only points not included within sequences of this specification.

3.02 INTERLOCK AND SAFETY CIRCUITS

- A. Close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized:
 - 1. The damper and actuators are specified in this section.
 - 2. Outdoor air damper shall be fully opened before related air handling unit fan is energized for 100% outside air use.
 - 3. Provide motorized outside air dampers for the following:
 - a. Supply fans
 - b. AHUs
 - c. Exhaust fans (except kitchen exhaust)
- B. Close the chilled and hot water valves to the coil when the related unit is de-energized.
- C. Interlock each chiller to start its dedicated chilled and condenser water pumps. Interlock flow switch and pump auxiliary contacts in series to chiller safety terminal strip.
 - 1. On shutdown provide a circuit to permit the chilled water pumps and condenser water pumps to run while the chillers pump down as required by the manufacturer.
 - 2. As per manufacturer's recommendations
- D. Primary chilled water control:
 - 1. Operating and safety controls are furnished as an integral part of the water-chilling unit and not specified in this section.
 - 2. Provide flow switches located in the chilled water and condenser water piping to each water-cooled liquid chiller.
 - a) Interlock to prevent operation in the absence of flow.
 - b) This may not be the prime controller to start/stop the chiller.
 - c) Interlock thru pump auxiliary contacts.
 - 3. Provide a high limit temperature sensor in each primary chilled water pump loop.
- E. Exhaust/Supply Fans:
 - 1. Interlock the related exhaust and supply fans and the related outside air damper.
 - 2. Interlock the exhaust fans with the related air-handling unit through software.
 - 3. Interlock related exhaust fan for dishwasher with time delay off relay.
 - 4. Interlock related exhaust fan for kiln with time delay off relay

5. Interlock kitchen hood related supply and exhaust fans.
 6. Provide additional interlocks as indicated on fan schedule and on drawings.
 7. Interlock electrical and mechanical room exhaust fans with thermostat.
 8. Interlock refrigerant monitor with mechanical room purge system.
 9. Interlock science room related supply and exhaust fans.
 10. Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.
- F. Cooling Tower Fan Safety Interlock: Provide interlock wiring for the vibration sensor, oil level switch and oil pump on each cooling tower fan.
- G. Freeze Protection:
1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition not limited to the following:
 - a. Outside Air Handling Units & Supply Fans with heating and cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, open both heating and cooling valves to enable full flow condition. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition, disable unit, close outside air damper, and open both heating and cooling valves to enable full flow condition. Ensure HW & CHW pumps are operational.
 - b. Boilers - Enable during a freeze condition.
 - c. Chillers – Open isolation valves then command by-pass valve to dump water into basin or by-pass tower. Enable condenser water pumps during a freeze condition.
 - d. Air Cooled Chillers – Open isolation valves, then enable pumps, run cycle for 15 minutes per hour, open all chilled water valves.
 - e. Protect coils downstream of DX cooling coil with freeze protection. If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, disable the DX cooling coil. If coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition.
 2. Temperature low limit switch wired with double pole single throw switch with one switch leg hard-wired to de-energize fan and one switch leg to signal BMCS.
- H. Drain Pan Float Protection:
1. Interlock to shut down unit and close valves.
 2. Cooling Coils mounted above ceiling and in roof mounted units.
 3. Provide for each cooling coil location.
 4. Signal BMCS alarm point
- I. Domestic Water System:
1. Interlock in-line circulating pumps at water heaters with return water pipe mounted thermostat to cycle pump with return water temperature.
 2. Interlock high temperature entering water solenoid valve with thermostat on discharge side of tempered water mixing valves.

- J. Emergency Shutdown Station:
 - 1. Provide an emergency mushroom style push / pull station shutdown switch in the Administration Area or as directed by Owner / Architect.
 - 2. Signal the building automation system to de-energize the HVAC equipment.
 - 3. This is to stop exhaust fans and outside air units immediately.
 - 4. Other air handling units, chillers and equipment shall be shut down in an orderly manner so as to not damage the equipment.
 - 5. Once stopped, the system may only be restarted with a key operated switch located adjacent to the shutdown switch.
- K. Science Room Utility Controllers:
 - 1. Interlock the utility controllers with related air-handling unit through software.
- L. Copper Tube Boiler:
 - 1. Interlock each boiler to start its dedicated primary circulating pump. Interlock flow switch and pump to boiler safety terminal strip.
 - 2. On startup enable boiler and primary pump prior to starting secondary system pump until primary loop temperature reaches 105 degrees as per manufacturer's recommendations.
 - 3. Disable secondary pump if boiler goes into alarm or fails to produce heating water within 30 minutes.
- M. Hydronic Heating Boiler:
 - 1. Interlock each boiler to start its dedicated pump.
 - 2. On startup enable boiler prior to starting primary pump. Boiler should reach operating temperature prior to starting system pump as per manufacturer's recommendations.
 - 3. Disable system pump if boiler goes into alarm or fails to produce heating water within 30 minutes.
- N. Condensing and Non-Condensing Hot Water Boilers:
 - 1. Interlock each boiler to start its dedicated pump.
 - 2. Install communication cable between each boiler and master controller specified by boiler manufacturer.
- O. Intrusion Alarm System:
 - 1. Interlock the intrusion alarm system for status of building occupancy.
 - 2. Disable HVAC system when building is in the unoccupied mode and alarm system is enabled. Either Time of Day Schedule and/or contact from the intrusion alarm system shall disable HVAC system.

3.03 GRAPHICS

- A. Furnish as-built drawings indicating finally corrected "as installed" diagram(s) of the complete Building Management Control System.
 - 1. Modification of existing control systems shall be included.
 - 2. These must be as-built and any changes during the warranty period drawings must be revised and updated.
 - 3. Provide final sequence of operation in written format.

- B. Provide a set of the "as installed" diagram(s) of the complete control system laminated in plastic and hung in the main mechanical room or as directed by Owner.
- C. Provide a color-coded floor plan of the building showing the location of each system, and the area served by each AHU or related zone. These must be of professional quality. Floor plan is to hang in main mechanical room near central control panel.
- D. Provide computer graphics for each system.
- E. Provide final graphic room numbers as selected by District. Any changes during the warranty period shall be included.

3.04 IDENTIFICATION

- A. Provide a laminated engraved nameplate on all control panels and devices shown on the "as installed" control diagrams. Coordinate engraving with nomenclature used on the diagrams.
- B. A black-white-black laminated plastic engraved identifying nameplate shall be secured to each terminal cabinet, and control panels. Identifying nameplates shall have ½ inch high, engraved letters.
- C. A red-white-red 2"x8" laminated plastic engraved identifying nameplate shall be secured to each audible/visual alarm and emergency shutdown device. Provide identification and location of each A/V device laminated in plastic and hung at refrigerant monitor with identification, location of devices and proper operation of system in a graphic floor plan with written sequence of operation. Identifying nameplates shall have ½ inch high, engraved letters. A red-white-red 12"x12" laminated plastic engraved identifying nameplate shall be secured to outside of each door to machine room with "A REFRIGERANT LEAK HAS BEEN DETECTED IN THIS BUILDING WHEN AUDIBLE/VISUAL ALARM IS ENABLED. DO NOT ENTER. CONTACT MAINTENANCE DEPARTMENT."
- D. A black-white-black laminated plastic engraved identifying nameplate shall be secured to ceiling grid directly below the control panel. Identifying name plates shall have ½" inch high engraved letters. White with black letters.

3.05 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

- A. Furnish and install all wire, conduit, raceways and cable systems required for the complete operation of the Building Management and Control System.
- B. All wiring for the Building Management and Control System is specified in this section and includes, but is not limited to:
 - 1. Wiring of interlock system.
 - 2. Wiring of control instruments.
 - 3. Wiring of control panels.
 - 4. Wiring of related power supplies, i.e. transformers.
 - 5. Wiring of 120 VAC power circuits for control panels and devices.
- C. All materials and methods specified in this section shall comply with the requirements

specified in Division 26 of this specification.

- D. All power supply requirements shall be connected to the building electrical distribution system in an approved manner. Do not connect control equipment of circuits common with other building loads or devices.
- E. Temperature control wiring shall be jacketed cables installed with or without conduit as specified below or single conductors installed in conduit. Control wiring shall have minimum 300V insulation for low voltage wiring and 600V insulation for line voltage wiring.
- F. All line voltage control wiring, all low voltage control wiring which is exposed in the central plant, penthouse, and other similar spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.
- G. All low voltage control wiring which is routed through concealed accessible locations may be run without conduit provided that the wiring run without conduit is properly supported from the building structure on maximum 5' centers and does not depend upon the ceiling grid or the ceiling support system for support. Wiring run in plenum spaces shall be plenum rated. Support all plenum wiring in accessible locations in bridge rings, J-hooks, D rings. Plenum wiring is not to be supported within building structure or attached to conduit raceways. All low voltage wiring must be installed through supports. Wires shall be supported on 5' centers and identified at each termination point and at 50' centers minimum. Install wire parallel or perpendicular to the structural features of the building.
- H. Line and low voltage control wiring shall not be installed in the same conduit with control wiring and shall not be installed in the same conduit with power wiring.
- I. All wiring associated with building management and control system cover shall be as follows:
 - 1. Sensor jacket color, Green
 - 2. LAN communications, Yellow
 - 3. All THHN wiring shall comply with Division 26 insulation color identification

3.06 EXHAUST AND SUPPLY FANS

- A. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.
- B. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.
- C. Provide by-pass timers for fans indicated in Fan Schedule and in the following locations:
 - 1. Fume Hoods
 - 2. Science Room exhaust fans

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay

POINT DESCRIPTION	TYPE	DEVICE
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.07 SYSTEM OVER-RIDE

- A. Provide manual over-ride push buttons and pilot lights installed in a single control panel at the main central plant for all functions.
 - 1. Overrides shall be located within a locked panel.
 - 2. Provide override switch for:
 - a. Chilled water central plant
 - b. Hot water central plant
 - c. Each Air Handling unit
 - d. Existing systems
 - e. Exhaust & supply fans

3.08 BUILDING ELECTRICAL USAGE

- A. Provide digital monitoring of the building KVA and KWH. Coordinate with the switchgear manufacturer.
- B. Electrical Quality monitoring:
 - 1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.

3.09 MISCELLANEOUS

- A. Freezer/Cooler Temperature Monitoring:
 - 1. Provide an analog temperature sensor located in the freezer compartment and cooler compartment.

POINT DESCRIPTION	TYPE	DEVICE
Freezer Alarm	AI	RTD
Cooler Alarm	AI	RTD

- B. Lighting Control:
 - 1. Provide individual time/photo-cell and time based control of each lighting contactor specified in Division 26.
 - 2. Provide momentary push buttons located at the central plant control panel, tennis courts, football, baseball, softball fields and/or concession stands to energize exterior lighting for a preprogrammed length of time.
 - a. Provide separate control of each contactor.

POINT DESCRIPTION	TYPE	DEVICE
Lighting Contactor	DO	Control Relay

POINT DESCRIPTION	TYPE	DEVICE
Momentary Control Switch	DI	Switch

- C. Photocell: Provide a photocell mounted on the north side of the building. Location is to be approved by Owner / Architect / Engineer.

POINT DESCRIPTION	TYPE	DEVICE
Photocell	AI	Contact

- D. Humidity Sensor: Provide a sensor in Library to monitor space conditions.

POINT DESCRIPTION	TYPE	DEVICE
Library Humidity	AI	Space Sensor

- E. Outside Air: Provide a temperature sensor and a humidity sensor to monitor outside air conditions.

POINT DESCRIPTION	TYPE	DEVICE
Outside Temperature	AI	Thermistor
Outside Humidity	AI	Humidity Sensor

- F. Solar Power Generation: Provide digital monitoring and logging of the solar power generation in KVA.

POINT DESCRIPTION	TYPE	DEVICE

- G. Wind Power Generation: Provide digital monitoring and logging of the wind power generation in KVA.

POINT DESCRIPTION	TYPE	DEVICE

- H. Cistern Water Level: Provide digital monitoring and logging, through the BMCS, of the cistern water level (inches). Coordinate with the cistern supplier and manufacturer.

POINT DESCRIPTION	TYPE	DEVICE

3.10 REFRIGERANT MONITORING / VENTILATION CENTRAL PLANT APPLICATIONS

- A. Install refrigerant monitor in the central plant and other locations as required by code. Monitor the concentration of refrigerant through an analog input signal through the BMCS. Install (2) sensors at each chiller at opposite ends. Alarm levels of refrigerant concentrations are provided in the Code. Refrigerant levels shall be available at the BMCS.
- B. Install audible and visual alarms in the area served, at locations as required by code. Audible sound pressure level of at least 15DbA above the operating ambient noise level within machine room and provide a distinctive strobe type visual alarm both inside and outside machine room at each entrance. Ceiling mounted rotating beacon in center of machine room. Strobes shall be provided immediately adjacent to and outside of each refrigeration machinery room exit. Provide visual and audible device installed at location as per local code.
- C. Provide a clearly identified switch of the break-glass type immediately adjacent to inside and outside of each refrigeration machinery room exit for emergency shutdown. Label switches / buttons per Code. Provide an emergency ventilation button for control in the central plant. Upon alarm either through the sensor or by manually pushing the button, the emergency exhaust fan shall be activated and deactivating all the mechanical equipment i.e. chillers and pumps thru safety circuits upon alarm.
- D. Provide ventilation control of the exhaust and supply fans and alarm the BMCS at the alarm condition number one. Provide ventilation control of the exhaust and supply fans, alarm the BMCS and signal the audible and visual alarms in the area served at alarm condition number two.

POINT DESCRIPTION	TYPE	DEVICE
Refrigerant Monitor / Sensors	AI	Control Panel
Emergency Buttons	DI	Button
Fan Start/Stop	DO	Control Relay
System Start/Stop	DO	Control Relay

3.11 INTERACTIVE INFORMATION BOARD (EDUCATIONAL DASHBOARD)

- A. The “Educational Dashboard” is a data monitoring and display system. The system shall include necessary hardware, software and programming that will allow the building owner to share energy efficiency information and green building features/strategies with the occupants of the building. The dashboard is meant to educate individuals on the

benefits of sustainable technologies and to create a spirit of cooperation for participation in the end.

- B. The system works by feeding “real-time” utility data, such as power, gas and water consumption,
- C. This system consists of two 42” diagonal, touch screen monitors mounted where shown of the drawings and a Dashboard Server as specified. The system will gather and display “real time” information from various sub-systems within the facility and other HTTP sources from the World Wide Webb.
 - 1. There shall be no annual contract renewal or recurring cost to the school district for maintaining the system
- D. The information will be indexed by touching icons depicting the information to be displayed on the monitor. The “real time” information shall include but not limited to the following:
 - 1. Building KW accumulative usage for the day and historical daily totals for the past 30 days.
 - 2. Building water usage for the day and historical daily totals for the past 30 days.
 - 3. Photovoltaic panel energy production shown in kW and kWh.
 - 4. Instantaneous building total air conditioning tonnage based on flow rate and supply and return water temperature differential.
 - 5. Rain water cistern water level.
 - 6. Educational Page:
 - a. This page will illustrate the sustainable features of the building.
 - b. Page could include pictures and diagrams to illustrate features, along with descriptions of how equipment works and what the economic advantages are.
 - 7. Dashboard capabilities could display the following features:
 - a. Home page components
 - b. Resource use, shown in real-time
 - c. Historical comparison graphs
 - d. Display building sustainable features
 - e. Environmental information and tips
 - f. Competition among building tenants
 - g. CHPS checklist
 - h. Other owner options

3.12 EXISTING AUTOMATION SYSTEM

- A. The new system shall be fully integrated with the existing Building Automation System Host computer located at the School District maintenance facility. If there is no existing manufacturer's host computer reference Article 2.11 in this section.
- B. The integrating shall include, but not be limited to, database additions, creation of graphics and implementing auto/answer and auto/dial telephone communications. Integration shall be consistent with District standards and practices.
- C. The bid for the control work shall be based on the premise that existing control devices are operational and are not in need of repair or replacement, unless otherwise noted.

- D. This subcontractor shall notify the Owner's representative of existing control devices that need to be replaced or repaired that may be noted in the process of installation of the new work.

3.13 NEW HOST COMPUTER REQUIREMENTS

- A. The District presently owns and operates a Building Management and Control System host computer to support a system. The existing host computer equipment is not available for use by other manufacturers other the existing BMCS.
- B. Provide a new Building Management and Control System host computer with printer located at the District's energy management office.
 - 1. Provide modem for management tasks.
 - 2. Make final connections necessary to provide a complete and functioning system.
- C. Provide color graphics software. Complete graphics of all systems specified in this contract.

3.14 EXISTING SYSTEMS

- A. Provide start/stop control for all the existing systems. Systems include all air-handling units, fan coil units, pumps, chillers, boilers, and fans. Provide one space temperature sensor for the optimum start/stop program for each system.
- B. The integrating shall include database additions, implementing auto/answer and auto/dial telephone communications.
 - 1. Implementation of the Districts existing facility management software is as follows:
 - a. Building optimum start/stop, minimum of ten zones.
 - b. Exterior lighting control.
 - c. Alarm functions.
 - 2. Point names must be approved by Owner.

POINT DESCRIPTION	TYPE	DEVICE
System Start/Stop	DO	Control Relay
Space Temperature	AI	Space Thermistor
Water Temperature	AI	Pipe sensor

3.15 FAN POWERED TERMINAL UNIT COORDINATION

- A. Equipment furnished in this section and installed by Section 23 36 16:
 - 1. Automatic temperature control card (DDC).
 - 2. Damper Actuator
- B. Equipment furnished and installed by Section 23 36 16:
 - 1. Damper.
 - 2. Multi-point flow sensor.

3. Power transformer.
4. Controller enclosure.

3.16 VARIABLE FREQUENCY DRIVE INTERFACE

- A. Interface to the VFD directly
- B. Interface may be hardwired or via RS-485
- C. The following points shall be available at a minimum:

<u>Point Name</u>	<u>Type</u>
Start-stop	DO
Drive alarm	DI
Last fault	AI
Reset drive	DO
Percent output	AI
Frequency output	AI
Speed	AI
Current	AI
Power	AI
Drive temperature	AI
KWH	AI
Run time	AI

3.17 SINGLE ZONE AIR HANDLING UNIT

- A. Consists of a chilled water coil and a hot water heating coil in the REHEAT position.
Control shall be as follows:
 1. A room thermistor sensing space temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired space temperature. The air-handling unit shall be started and stopped from the BMCS System.
 - a. If an outside air unit provides the outside air for single-zone air handling unit, the outside air unit shall be activated during the occupied periods.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
HW Valve	AO (1)	Electronic Operator
CHW Valve	AO (1)	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor

3.18 SINGLE ZONE AIR HANDLING UNITS WITH HUMIDITY CONTROL

- A. These units are furnished with a chilled water cooling coil and a hot water coil in the reheat coil position. Controls shall be as follows:
1. A space temperature sensor shall, acting through the DDC panel, modulate the valves on the chilled water cooling coil and hot water reheat coil, in sequence, to maintain the desired space temperatures.
 2. A humidity sensor, located in the space shall acting through the DDC panel, modulate the valve in the chilled water coil to maintain 55 degree discharge air when space is above its humidity setpoint and in dehumidification.
 - a. The space temperature sensor shall modulate the valve on the hot water reheat coil to maintain space temperature.
 3. The Space Humidity Sensor shall monitor the space relative humidity at all times. If the space relative humidity rises above the setpoint when the system is de-energized, over-ride the BMCS.
 - a. Energize Air Handling Unit and Central Plant Equipment.
 - b. Outside air damper shall remain closed and related exhaust fans de-energized.
 4. If an outside air unit provides the outside air for single-zone air handling unit, the outside air unit shall be activated during the occupied periods.
 5. Provide a CO₂ monitor located in the inlet side of the air-handling unit.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
CHW Valve	AO	Electronic Operator
Chilled Water Coil Discharge	AI	Duct Thermistor
Outside Air Damper	DO	Electronic Operator
Space Humidity	AI	Humidity Sensor
HW Valve	AO	Electronic Operator
Return Air Humidity	AI	Humidity Sensor
Discharge Air Temperature	AI	Duct Thermistor
CO ₂ Concentration	AI	CO ₂ Monitor

3.19 SINGLE ZONE AIR HANDLING UNIT WITH OUTSIDE AIR DEHUMIDIFICATION

- A. Outside Air Pre-Treat Section on these units are furnished with a chilled water coil and a hot water heating coil in the PREHEAT position. Control shall be as follows:
1. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature of 55°F. The supply fan shall be started and stopped from the BMCS System.
 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Discharge Air Temperature	AI	Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch
HW Pre Heat Valve	AO	Electronic Operator

- B. Supply Air Section of AHU Consists of a chilled water coil and a hot water heating coil in the REHEAT position. Control shall be as follows:
1. A room thermistor sensing space temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired space temperature. The air-handling unit shall be started and stopped from the BMCS System.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
HW Valve	AO (1)	Electronic Operator
CHW Valve	AO (1)	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor

POINT DESCRIPTION	TYPES	DEVICE
Space Humidity	AI	Humidity Sensor
CO ₂ Sensor	AI	CO ₂ Sensor

3.20 SINGLE ZONE AIR HANDLING UNIT WITH SPLIT DEHUMIDIFICATION UNIT MOUNTED ON TOP

- A. Split dehumidification units are furnished with a chilled water coil and a hot water heating coil in the PREHEAT position. Control shall be as follows:
1. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature of 55°F. The supply fan shall be started and stopped from the BMCS System.
 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.
 3. Open OA damper and start supply fan before starting Air Handling Unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

POINT DESCRIPTION	TYPES	DEVICE
Supply Fan Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch
HW Pre Heat Valve	AO	Electronic Operator

- B. AHU Consists of a chilled water coil and a hot water heating coil in the REHEAT position. Control shall be as follows:
1. A room thermistor sensing space temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired space temperature. The air-handling unit shall be started and stopped from the BMCS System.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
HW Valve	AO (1)	Electronic Operator
CHW Valve	AO (1)	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor

3.21 SINGLE ZONE AIR HANDLING UNITS

- A. These units consist of a chilled water coil and an electric duct heater in the supply duct. Control shall be as follows:
1. A room Thermistor sensing space temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and stage the electric duct heater, in sequence, to maintain the desired space temperature. The air-handling unit shall be started and stopped from the BMCS System.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	DI	Space Thermistor
Electric Duct Heater	DO	Relay each stage
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor

3.22 SINGLE ZONE AIR HANDLING UNITS WITH HUMIDITY CONTROL

- A. These units consist of a chilled water coil and an electric duct heater in the supply duct. Control shall be as follows:
1. A space temperature sensor shall, acting through the DDC panel, modulate the valves on the chilled water cooling coil and stage the electric duct heater in sequence to maintain the desired space temperatures.

2. A humidity sensor, located in the return air and/or in the space shall, acting through the DDC panel, modulate the valve on the chilled water coil to maintain 55 degree discharge air when space is above its humidity setpoint and in dehumidification.
 - a. The space temperature sensor shall stage the duct heater to maintain space temperature.
3. The Space Humidity Sensor shall monitor the space relative humidity at all times. If the space relative humidity rises above the setpoint when the system is de-energized, over-ride the BMCS.
 - a. Energize Air Handling Unit and Central Plant Equipment
 - b. Outside air damper shall remain closed and related exhaust fans de-energized

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
CHW Valve	AO	Electronic Operator
Chilled Water Coil Discharge	AI	Duct Thermistor
Outside Air Damper	DO	Electronic Operator
Space Humidity	AI	Humidity Sensor
Electric Heater	DO	Relay
Discharge Air Temperature	AI	Duct Thermistor

3.23 SINGLE ZONE AIR HANDLING UNITS CONTROL W/VARIABLE FREQUENCY DRIVE

- A. This unit is furnished with a chilled water coil, a hot water heating coil in the reheat position, and a variable frequency drive. Control shall be as follows:
 1. A room Thermistor sensing space temperature through the Direct Digital Control Panel shall vary the speed of the fan to maintain room setpoint. The air volume of the fan can range from 100% to 50% of the air quantity specified. A leaving air temperature sensor in the duct through the Direct Digital Control Panel shall modulate the cooling coil control valve to maintain the 55F leaving air temperature. When the fan is at 50% of its specified air quantity and the room temperature is below the room setpoint, the room Thermistor shall modulate the valve on the cooling coil and the valve on the hot water coil in sequence to maintain the desired space temperature. A room humidity sensor shall override the operation of the cooling coil control valve to maintain the relative humidity setpoint in the space. The room temperature sensor shall modulate the hot water reheat coil control valve to maintain the space temperature. The dehumidification sequence only applies after the fan has reached 50% of the specified air quantity.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
CHW Valve	AO	Electronic Operator
HW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Space Thermistor
Variable Speed Motor	AO	Motor Controller
Discharge Air Temperature	AI	Duct Thermistor

3.24 SINGLE ZONE AIR HANDLING UNITS WITH HUMIDITY CONTROL

- A. These units are furnished with a hot water preheat coil, chilled water cooling coil, and a hot water reheat coil. Controls shall be as follows:
1. A space temperature sensor shall, acting through the DDC panel, modulate the valves on the chilled water cooling coil and hot water reheat coil in sequence to maintain the desired space temperatures.
 2. A space humidity sensor located in the return air and/or in the space shall acting through the DDC panel, modulate the valve on the chilled water coil to maintain 55 degree discharge air when space is above its humidity setpoint and in dehumidification.
 - a. The space temperature sensor shall modulate the valve on the hot water reheat coil to maintain space temperature.
 3. An averaging temperature sensor, located in the preheat discharge shall modulate the hot water control valve to maintain the desired setpoint.
 4. If an outside air unit provides the outside air for single-zone air handling unit, the outside air unit shall be activated during the occupied periods.
 5. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 37°F. Device shall be manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay

POINT DESCRIPTION	TYPES	DEVICE
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
CHW Valve	AO	Electronic Operator
Chilled Water Coil Discharge	AI	Duct Thermistor
Outside Air Damper	DO	Electronic Operator
Space Humidity	AI	Humidity Sensor
HW Valve (preheat)	AO	Electronic Operator
HW Valve (reheat)	AO	Electronic Operator
Discharge Air Temperature	AI	Temperature Sensor
Freeze Status	DI	Temperature Low Limit Switch

3.25 SINGLE ZONE DX AIR HANDLING UNIT

- A. Consists of a direct expansion coil and hot water coil in the reheat position. Control shall be as follows:
1. A room thermistor sensing space temperature shall, acting through the Direct Digital Control Panel, energize the first stage of cooling, modulate the valve on the heating water in sequence, to maintain the desired space temperature. The air handling unit shall be started and stopped from the BMCS System.
 - a. If an outside air unit provides the outside air for single zone air handling unit, the outside air unit shall be activated during the occupied periods.
 2. A discharge air temperature sensor shall stage the electric duct heat to maintain 55°F.
 3. Start/stop of the unit shall be by BMCS.
 4. Provide a temperature low limit switch located on the discharge side of the hot water reheat coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor

HW Valve	AO(1)	Electronic Operator
Condensing Unit	DO	Control Relay(s)
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor
Freeze Status	DI	Temperature Low Limit Switch

MULTIZONE AIR HANDLING UNITS

3.26 MULTI-ZONE AIR HANDLING UNITS

- A. These units consist of a chilled water cooling coil in the Cold Deck Zone, hot water heating coils in the zone ductwork and zone mixing dampers. Control shall be as follows:
1. A room thermistor sensing zone space temperature in each zone shall, acting through the Direct Digital Control Panel, modulate its zone mixing dampers and zone hot water valves, in sequence, to maintain the space temperature. The mixing damper must be in the full bypass position before the hot water valve is allowed to operate. The air-handling unit shall be started and stopped from the BMC System.
 2. An averaging temperature sensor located in the cold deck discharge shall, acting through the Direct Digital Control Panel, modulate the chilled water control valve to maintain setpoint. Reference the drawing schedule for discharge temperature requirements.
 3. Adjustment of damper linkages for single and multi-blade control is the responsibility of this Section.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Cold Deck Temperature	AI	RTD Average Probe
CHW Valve	AO	Electronic Operator
Zone Space Temperature	AI	Space Thermistor
Zone Damper	AO	Electronic Operator
HW Valve	AO	Electronic Operator

OUTSIDE AIR – AIR HANDLING UNITS

3.27 OUTSIDE AIR HANDLING UNIT CONTROL

- A. These units are furnished with a chilled water coil and a hot water heating coil in the PREHEAT position. Control shall be as follows:
1. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature of 55°F. The air-handling unit shall be started and stopped from the BMCS System.
 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.
 3. Open OA damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch
HW Pre Heat Valve	AO	Electronic Operator

3.28 OUTSIDE AIR – AIR HANDLING UNITS

- A. These units consist of a hot water preheat coil, chilled water cooling coil and a hot water reheat coil. Control shall be as follows:
1. A temperature sensor located in the discharge of the hot water preheat coil shall, through the Direct Digital Control Panel, modulate the hot water control valve to maintain a 55°F discharge temperature (adjustable).
 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil to de-energize the air-handling unit when the temperature drops below 37°F. Device shall be manual reset and signal an alarm to the BMCS. Provide freeze protection sequence.
 3. A temperature sensor located in the discharge of the air handling unit shall, through the Direct Digital Control Panel, modulate the hot water reheat control valve and chilled water control valve to maintain setpoint. Reference the schedule for discharge temperature requirements.
 4. Open O.A. Damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Discharge Thermistor
HW Reheat Valve	AO	Electronic Operator
HW Preheat Valve	AO	Electronic Operator
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch

3.29 OUTSIDE AIR HANDLING UNIT CONTROL

- A. These units are furnished with a chilled water coil and an electric duct heater in the duct supplying the unit. A duct mounted sensor sensing supply air temperature shall, modulate the valve on the cooling coil and stage the electric duct heater in sequence to maintain the desired supply temperature of 55°F. The air-handling unit shall be started and stopped from the BMCS System.
- B. Provide a temperature low limit switch located on the discharge side of the electric duct heater to de-energize the air-handling unit when the temperature drops below 37°F. Close the outside air damper, activate the duct heater 100%, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset. Provide freeze protection sequence.
- C. Open O.A. damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator

POINT DESCRIPTION	TYPE	DEVICE
Freeze Status	DI	Temperature Low Limit Switch
Electric Heater	DO	Relay each stage

3.30 DX OUTSIDE AIR UNITS

- A. These units are furnished with a direct expansion coil and electric heating coil in the reheat position. Control shall be as follows:
1. An ambient temperature sensor shall energize the first stage of cooling whenever the ambient temperature rises above 56°F (adjustable) and energize the second stage of cooling whenever the temperature is above 76°F (adjustable).
 2. De-energize the DX cooling whenever the ambient temperature is below 55°F (adjustable).
 3. Internal unit controls shall operate the hot gas bypass and defrost safeties as required.
 4. A discharge air temperature sensor shall stage the electric duct heat to maintain 55°F.
 5. Start/stop of the unit shall be by BMCS.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Condensing Unit	DO	Control Relay(s)
Discharge Air Temperature	AI	Discharge RTD
Electric Heater	AO	Relay(s)
Status	DI	Air Flow Switch
Outside Air Damper	DO	Electronic Operator
Ambient Temperature	AI	Thermistor

ROOF TOP UNITS

3.31 PACKAGED ROOFTOP UNIT

- A. A room thermistor sensing space temperature shall sense room temperature.

POINT DESCRIPTION	TYPES	DEVICE
Space Temperature	AI	Space Thermistor
Start/Stop	DO	Control Relay

POINT DESCRIPTION	TYPES	DEVICE
AHU Status	DI	Current Sensitive Relay
Cooling Stages	DO	Control Relay
Heating Stages	DO	Control Relay

3.32 PACKAGED ROOFTOP VARIABLE VOLUME UNIT CONTROL

- A. Each system consists of a packaged roof mounted variable volume air conditioning unit with factory-mounted controls.
 - 1. Discharge air temperature control specified in Section 23 74 15.
 - 2. Static pressure control specified in Section 23 74 15.
- B. Coordinated required interlocks of factory mounted control equipment.
- C. Provide BMCS start/stop control of unit.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Discharge Air Temperature	AI	Duct Thermistor

3.33 PACKAGED ROOF MOUNTED AIR CONDITIONING UNIT WITH GAS HEAT

- A. These consist of a single stage cooling unit with gas-fired heat.
- B. A space sensor shall, through a direct digital control panel, stage the cooling and heating to maintain space temperature. The air-handling unit shall be started and stopped from the BMCS system.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Space Temperature	AI	Space Thermistor
Cooling	DO	Relay
Heating	DO	Relay
Draft Blower	DO	Relay
Discharge Air Temperature	AI	Duct Thermistor

3.34 PACKAGED ROOFTOP AIR CONDITIONING UNIT

- A. Each system consists of a packaged roof mounted air conditioning unit.
- B. Low voltage thermostat specified in Section 23 81 19.
- C. Provide BMCS start/stop control of unit.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Discharge Air Temperature	AI	Duct Thermistor

3.35 DX ROOFTOP UNITS

- A. Each roof top unit is furnished with a low voltage thermostat. The BMCS shall provide start / stop control. Provide a temperature sensor in the space to provide optimum start / stop.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Space Temperature	AI	Space Thermistor
Discharge Air Temperature	AI	Duct Thermistor

3.36 PACKAGED ROOFTOP UNIT

- A. A room thermistor sensing space temperature shall, through a direct digital control panel, stage the cooling and heating to maintain space temperature. The unit shall be started and stopped from the BMCS system.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Space Temperature	AI	Space Thermistor
Cooling Stages	DO	Relay
Heating Stages	DO	Relay
Discharge Air Temperature	AI	Duct Thermistor

KITCHEN HOOD VENTILATION SYSTEM

3.37 KITCHEN HOOD SUPPLY AIR HEATING SYSTEM

- A. This system consists of a duct mounted hot water coil.
- B. A thermistor sensing discharge air from the hot water coil shall, through the direct digital control panel, modulate the hot water valve to maintain a 70°F discharge temperature (adjustable).
- C. Provide an electric low temperature switch located in the discharge of the hot water preheat coil to de-energize the supply air fan and close the outside air damper, open the hot water valve 100%, start the hot water pump, and signal the BMCS, when temperature drops below 32°F. Device shall be manual reset.
- D. Provide a space temperature sensor to limit the rise in temperature during unoccupied times.
- E. Provide interlocks to disable the fans during unoccupied times.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Discharge Air Temperature	AI	Discharge Thermistor
HW Valve (Preheat)	AO	Electronic Operator
Freeze Status	DI	Low Temperature Switch
Space Sensor	AI	Space Thermistor

3.38 KITCHEN HOOD SUPPLY AIR HEATING SYSTEM

- A. This system consists of a duct mounted electric duct heater and a supply fan.
- B. A RTD sensing discharge air from the electric duct heater shall, through the direct digital control panel, stage the electric duct heater to maintain a 70° F discharge temperature (adjustable).

POINT DESCRIPTION	TYPES	DEVICE
Supply Fan	DO	Control Relay
Discharge Air Temperature	AI	Discharge RTD
Electric Heater	DO	Relay each stage

ROOM TERMINAL UNITS

3.39 CONSTANT VOLUME / VARIABLE VOLUME TERMINAL UNITS

- A. Each unit shall consist of a pressure independent variable volume damper, a constant volume fan, and a hot water heating coil. The fans shall be interlocked with the AHU fan. Constant volume terminal shall start before AHU fan starts. Controls shall be as follows:
1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper from full open to a minimum airflow rate to maintain room setpoint. If heating is required, the temperature sensor shall modulate the hot water control valve to maintain room setpoint with the variable volume damper in the minimum airflow position.
 2. Control valve, and control valve operator are specified in this section.
 3. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, damper position, and hot water valve position.

POINT DESCRIPTION	TYPES	DEVICE
Space Temperature	AI	Space Thermistor
Primary Air	AO	Variable Volume Damper Operator
HW Valve	AO	Electronic Operator
Start/Stop	DO	Control Relay
Discharge Air Temperature	AI	Duct Thermistor

3.40 VARIABLE VOLUME TERMINAL UNIT CONTROL

- A. Each unit consists of a variable volume damper, supply fan and electric heating coil.
- B. The space temperature sensor shall, through the DDC terminal equipment controller, energize the unit fan, modulate the variable volume damper and stage the electric heating coil to maintain space temperature.
- C. Interlock the variable volume damper closed and the supply fan unit fan to start prior to energizing the related air-handling unit.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Zone Space Temperature	AI	Space Thermistor
Volume Damper	AO	Electronic Operator
Electric Heat	DO	Relays

POINT DESCRIPTION	TYPES	DEVICE
Discharge Air Sensor	AI	Duct Thermistor

VARIABLE VOLUME AIR HANDLING UNITS

3.41 VARIABLE VOLUME AIR HANDLING UNITS

- A. Units consist of a chilled water coil, a fan, a variable speed drive, and outside air fan.
- B. The unit shall be started and stopped from the BMCS system.
- C. Discharge air temperature control:
 - 1. A sensor far enough from the fan discharge to be truly representative of the average temperature shall modulate the valve on the cooling coil to maintain setpoint. Reference drawing schedule for discharge temperature.
- D. Variable air volume control:
 - 1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
 - 2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
 - a. Transmit a signal to the supply fan motor speed controller.
 - b. Modulate the fan speed to maintain the desired static pressure.
 - c. Coordinate signal with the fan motor speed controller.
 - 3. Install a static pressure high limit safety device to de-energize the system.
 - a. Manual reset.
- E. Outside air Fan control:
 - 1. Each unit will be provided with an outside air supply fan. The supply fan will be activated with the air-handling unit.
 - 2. A hot water coil or electric heating coil shall be supplied in the outside air ductwork. A duct mounted temperature sensor shall modulate a hot water valve or stages of heat to maintain a leaving air temperature of 55°F (adjustable).
 - 3. Provide a temperature low limit switch located on the discharge side of the preheating unit to de-energize the air handling unit, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 37°F. Device shall be manual reset.
 - 4. During warm-up and cool-down periods (optimum start/stop), the outside air fans shall not be activated. During occupied times, the fans shall be activated.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Space Thermistor

POINT DESCRIPTION	TYPES	DEVICE
CHW Valve	AO	Electronic Operator
Outside Air Fan	DO	Control Relay
Outside Air Preheat Valve or Electric Heating Unit	AO DO	Electronic Operator or Relay for each stage
Outside Air Temperature	AI	Duct Thermistor
Duct Static Pressure	AI	Static Pressure Sensor
Variable Speed Fan	AO	Motor Controller
Freeze Status	DI	Temperature Low Limit Switch

3.42 VARIABLE VOLUME AIR HANDLING UNIT CONTROL

- A. Discharge air temperature control:
 1. An electronic sensor in the unit discharge shall, through the DDC, modulate the valve on the cooling coil to maintain setpoint. Reference drawing schedule for discharge temperature.
- B. Variable air volume system control:
 1. Provide two static pressure sensors at the ends of the two longest duct runs at each unit.
 - a. Locate in the supply duct far enough from the fan discharge to be truly representative of the average static pressure in the system.
 - b. Coordinate with the work in Division 1.
- C. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
 1. Transmit a 4-20 MA signal to the supply fan motor speed controller.
 2. Modulate the fan speed to maintain the desired static pressure.
 3. Coordinate with the fan motor speed controller specified in another section.
 4. Install a static pressure high limit safety device to de-energize the system.
 - a. Manual reset.
- D. Outside air volume control:
 1. Each unit will be provided with an outside air supply fan. The supply fan will be activated with the air handling.
 2. A hot water coil shall be supplied in the outside air ductwork. A duct mounted temperature sensor shall modulate a hot water valve to maintain a leaving air temperature of 55°F (adjustable).
 3. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil to de-energize the air handling unit, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 37°F. Device shall be manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature	AI	Space Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Fan	DO	Control Relay
Outside Air HW Valve	AO	Electronic Operator
Outside Air Temperature	AI	Duct Thermistor
Static Pressure	AI	Static Pressure Sensor
Variable Speed Motor	AO	Motor Controller
Freeze Status	DI	Temperature Low Limit Switch

3.43 VARIABLE VOLUME DUAL DUCT AIR HANDLING UNITS

- A. Units consist of a chilled water coil, a hot water coil, a fan, and a variable speed drive. Controls shall be as follows:
1. An electronic averaging duct sensor in the cold duct shall, acting through the DDC System, modulate the chilled water valve to maintain desired setpoint. An electronic averaging duct sensor in the hot deck shall, acting through the DDC system, modulate the hot water valve to maintain desired setpoint. A schedule shall be set up for the hot deck temperature based on outside air temperature. The temperature of the hot deck shall modulate between the following criteria. If the temperature outside is 50°F (adjustable) or below, the hot deck temperature shall be 95°F; if the outside temperature is 75°F or above, the hot deck coil shall be deactivated.
 2. The unit shall be started and stopped from the BMCS system.
 3. An electronic duct static pressure sensor shall be located in the cold duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93. The sensor shall transmit a signal to the supply fan motor speed controller, and modulate the fan speed to maintain a supply duct static pressure. A high limit static pressure sensor with manual reset, located at the fan discharge, shall de-energize the supply fan when sensing pressure above duct construction capabilities. Fan start-up shall be initiated at minimum air speed.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay

POINT DESCRIPTION	TYPES	DEVICE
AHU Status	DI	Current Sensitive Relay
Discharge Air Temperature (2)	AI	Duct Temperature Sensor, One Each Deck
HW Valve	AO	Electronic Operator
CHW Valve	AO	Electronic Operator
Duct Static Pressure (2)	AI	Static Pressure Sensor, One Each Deck
Fan Speed	AO	Motor Controller

3.44 DOUBLE DUCT VARIABLE VOLUME TERMINAL UNITS

- A. Each unit shall consist of two pressure independent variable volume dampers, one on each duct inlet connection. Controls shall be as follows:
1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper on the cold deck from full open to 40% air flow rate to maintain room setpoint. When heating is required, the temperature sensor shall first modulate the variable volume damper on the hot duct and cold deck while maintaining 40% airflow. If more heating is required, the temperature sensor shall modulate the variable volume damper on the hot deck from 40% to full open to maintain room setpoint.
 2. The BMCS Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, and damper position.
 3. The BMCS Contractor shall furnish the terminal box manufacturer the control flow diagram for correct mounting of flow measurement devices, wiring of actuators, and terminal equipment controllers.

POINT DESCRIPTION	TYPE	DEVICE
Space Temperature	AI	Space Thermistor
Primary Air (2)	AO	Variable Volume Damper Operator
CFM Flow	AI	Control Panel

FAN COIL UNITS

3.45 FAN COIL UNITS

- A. Each fan coil unit is furnished with a chilled water coil and hot water coil. Control shall be as follows:
1. A space temperature sensor shall, acting through a terminal equipment controller, modulate the valves on the chilled water cooling coil and hot water reheat coil in sequence to maintain the desired space temperatures.

2. Start/stop of fan coil unit shall be by terminal equipment controller.
3. The outside air units providing the outside air shall be activated when the fan coil units are operating during the occupied periods.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
CHW Valve	AO	Electronic Operator
Space Temperature	AI	Space Thermistor
HW valve	AO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor

3.46 DX FAN COIL UNITS

- A. Each fan/coil unit is furnished with a direct expansion coil and hot water heating coil. Control shall be as follows:
1. A space temperature sensor shall, acting through a terminal equipment controller, stage the DX cooling and modulate the hot water heating coil control valve in sequence, to maintain the desired space temperature.
 2. Start/stop of fan coil unit shall be by terminal equipment controller.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Condensing Unit	DO	Control Relay
Space Temperature	AI	Space Thermistor
Heating Coil	AO	Electronic Operator
Status	DI	Air Flow Switch
Discharge Air Sensor	AI	Duct Thermistor

3.47 DX FAN COIL UNITS

- A. Each fan/coil unit is furnished with a direct expansion coil. Control shall be as follows:
1. A space temperature sensor shall, acting through a terminal equipment controller, stage the DX cooling coil to maintain the desired space temperature.
 2. Start/stop of fan coil unit shall be by terminal equipment controller.

POINT DESCRIPTION	TYPES	DEVICE

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Condensing Unit	DO	Control Relay
Space Temperature	AI	Space Thermistor
Status	DI	Current Relay
Discharge Air Sensor	AI	Duct Thermistor

HEATERS

3.48 ROOM HEATERS

- A. Each room heater is furnished with a fan and a hot water coil. Controls shall be as follows:
1. A space temperature sensor with an adjustable setpoint on the sensor shall, acting through a terminal equipment controller, activate the unit and modulate the hot water valve to maintain the desired space temperatures.
 2. Start/stop of fan coil unit shall be by terminal equipment controller.
 3. The fan for the room heater shall be interlocked with the outside air unit that serves the room heater such that any time the outside air unit is activated the room heater shall also be activated.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Space Temperature	AI	Space Thermistor
HW valve	AO	Electronic Operator

3.49 CORRIDOR HEAT

- A. Where the corridors are served from the outside air units and heat is provided in the corridor from a duct mounted hot water coil, provide a temperature sensor to control the hot water control valve.

POINT DESCRIPTION	TYPES	DEVICE
Space Temperature	AI	Space Thermistor

3.50 ELECTRIC UNIT HEATERS

- A. An electric thermostat shall activate the unit and stage the electric coil to maintain room

setpoint.

3.51 ENERGY RECOVERY UNIT

- A. Each ERU has its own controls. BMCS shall enable unit and open outside air and exhaust air damper. Interlock ERU with the related air handling units.
- B. The BMCS controls for energy recovery unit shall function as follows:
 - 1. The system shall be automatically started and stopped by the BMCS panel whenever the hand-off-automatic switch is in the automatic position, and manually started and stopped by the hand position. The unit shall run when either AHU is enabled.
 - 2. The energy recovery unit's internal controls shall be energized, and the dampers shall open prior to starting the energy recovery unit outside air and exhaust fans.
 - 3. The internal controls shall start the energy recovery unit wheel rotation and modulate the wheel speed to maintain a leaving outside air temperature of 56° F in the winter mode and 79° F in the summer mode but not exceeding 50% relative humidity.
 - 4. The energy recovery unit's internal controls shall shut down fans upon receiving a signal from the BMCS panel showing the AHU's are disabled.
 - 5. On power interruption or fan shutdown, all the dampers shall close.
 - 6. Smoke detector in the outside air duct downstream of the energy recovery unit shall automatically shut down the fans.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop OA Fan	DO	Control Relay
Status OA Fan	DI	Current Relay
Start/Stop EF Fan	DO	Control Relay
Status EF Fan	DI	Current Relay
Energy Recovery Wheel VFD	DO	Control Relay
Energy Recovery Wheel VFD Status	DO	Control Relay
Entering OA Temp	AI	Thermistor
Entering OA Humidity	AI	Relative humidity sensor
Leaving OA Temperature	AI	Thermistor
Leaving OA Humidity	AI	Relative humidity sensor
Entering EA Temperature	AI	Thermistor
Entering EA Humidity	AI	Relative humidity sensor

POINT DESCRIPTION	TYPES	DEVICE
Leaving EA Temperature	AI	Thermistor
Leaving EA Humidity	AI	Relative humidity sensor
Differential Across Filters	DI	High / Low limit Switch
EA & OA Dampers	DO	Control Relay

SCIENCE ROOM FANS

3.52 LABORATORY HOOD FANS

- A. The laboratory hoods fans shall be provided with a lighted switch mounted on the face of the hood. The BMCS shall have disable and enable capabilities.
- B. Interlock outside air damper and exhaust and supply fans.

POINT DESCRIPTION	TYPES	DEVICE
Enable/Disable	DO	Control Relay
Fan Status	DI	Current Sensitive Relay

3.53 LABORATORY PURGE FANS

- A. The laboratory purge fan system shall consist of an exhaust fan and an interlocked supply fan. The system shall be activated by an emergency push button. The BMCS shall have fan status and provide an alarm if a purge system is activated.
- B. Interlock outside air damper and exhaust and supply fans.

POINT DESCRIPTION	TYPES	DEVICE
Fan Status Alarm	DI	Current Sensitive Relay
Enable/Disable	DO	Control Relay

AIR COOLED CHILLERS

3.54 CHILLED WATER COOLING SYSTEM

- A. Systems consist of **a single** packaged air-cooled chiller with dedicated chilled water pump.
- B. Whenever there is a call for cooling in the system energize the system.

- C. Reference interlock and safety circuits for interlocks and shut down.

POINT DESCRIPTION	TYPE	DEVICE
Chiller Start/Stop	DO	Control Relay
Chiller Status	DI	Safety Alarm Relay
Pump Start/Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Building Supply/Return	AI	Temperature Sensors

3.55 CHILLED WATER COOLING SYSTEM

- A. This system consists of a single packaged air-cooled chiller with dedicated chilled water pump.
- B. Whenever there is a call for cooling in the system energize the system.
- C. Reference interlock and safety circuits for interlocks and shut down.

POINT DESCRIPTION	TYPE	DEVICE
Chiller Start/Stop	DO	Control Relay
Status (Chiller)	DI	Safety Alarm Relay
Pump Status	DI	Current Sen. Relay
Pump Start/Stop	DO	Control Relay
Building Supply/Return	AI	Temperature Sensors

3.56 CHILLED WATER SYSTEM CONTROL

- A. Sensors each located in the common chilled water supply header and the common chilled water return header shall, through a DDC controller, provide appropriate signals:
- Signal #1 - Chilled water return temperature drop to 47°F (adjustable).
 - Signal #2 - Chilled water supply temperature rise above 44°F (adjustable).
- B. System A shall run continuously, during hours of operation, meeting all loads.
- C. Signal #1 shall de-energize System B.
- Signal #2 shall energize System B.

- D. Provide lead/lag sequencing to alternate lead chiller on a daily basis, based on total run time.

POINT DESCRIPTION	TYPE	DEVICE
Chiller Start/Stop	DO	Control Relay (each chiller)
Common Chiller water supply	AI	Pipe RTD
Common Chiller water return	AI	Pipe RTD
Status (Chiller)	DI	Safety Alarm Relay (each chiller)
Condenser water supply Temp.	AI	Pipe RTD (each chiller) Temp.
Chilled water supply	AI	Pipe RTD (each chiller) Temp.

3.57 CHILLED WATER SYSTEM CONTROL

- A. The system consists of EDIT two packaged air-cooled chiller and two dedicated chilled water pumps.
- B. The lead chilled water pumping system will be energized whenever there is a call for cooling in the building system. The lag-chilled water pumping system will be energized whenever the return water temperature is higher than 52°F. The lag-chilled water pumping system will be deactivated when the return water temperature is less than 46°F.
- C. The lead/lag position shall be alternated every 24 hours based on total run time.
- D. Reference interlock and safety circuits for interlocks and shut down.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Pump Start/Stop	DO	Control Relay
Chiller Status	DI	Run Contact
Chiller Alarm	DI	Safety Alarm Contact
Pump Status	DI	Current Sensitive Relay
Building Supply/Return Temperature	AI	Pipe RTD (2 each)
Chiller Supply Temperature	AI	Pipe RTD

3.58 CHILLED WATER SYSTEM CONTROL

- A. Temperature sensors located in the building common chilled water supply and return piping and the turbine flow meter located in the building chilled water common supply piping shall, acting through the DDC system, be used to calculate the building BTUH requirements.
- B. Chillers 1 & 2 with their respective pumps shall be System 1. Chillers 3 & 4 with their respective pump shall be System 2. Chillers 5 & 6 with their respective pumps shall be System 3.
- C. During start-up, System 1 primary pumps shall start. After flow has been indicated from the flow switch for an adjustable time period, the System 1 chillers shall be activated.
- D. When the load calculated from the temperature sensors and flow meter exceeds the capacity of System 1 for an adjustable time period, the System 2 primary pumps and chillers shall be activated. When the load calculated from the temperature sensors flow meter exceeds the capacity of System 1 and System 2 for an adjustable time period, the System 3 primary pumps and chillers shall be activated.
- E. If the load drops to below half the capacity (adjustable) of one system, then the lag chillers will be deactivated. The primary pumps serving the chillers will remain on for 3 minutes (adjustable) and then be deactivated.
- F. A temperature sensor located in the chiller by-pass piping shall send an alarm to the host computer and shall start the lag chillers after an adjustable time delay, if the temperature in the by-pass is above 3 degrees (adjustable) higher than the temperature in the common supply from the chillers. This indicates the flow is moving from the primary loop to the secondary loop.
- G. Provide time delays between pump starts and stops to allow system to stabilize.
- H. Change lead/lag rotation on a weekly basis.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Chilled Water Supply Temperature	AI	Pipe RTD (1 each)
Pump Start / Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Building Flow	AI	Turbine Flow Meter
Building Supply/Return Water Temp.	AI	Temperature Sensors
Bypass Temperature	AI	Temperature Sensor

POINT DESCRIPTION	TYPES	DEVICE
Common Chiller Supply Temperature	AI	Temperature Sensor
Common Chiller Return Temperature	AI	Temperature Sensor

3.59 CHILLED WATER SYSTEM CONTROL (GYMNASIUM PLANT)

- A. The system consists of a single package air-cooled chiller and dedicated chilled water pump.
- B. The chilled water pumping system will be energized whenever there is a call for cooling in the building system.
- C. Reference interlock and safety circuits for interlocks and shut down.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Chiller Status	DI	Safety Alarm Relay
Pump Start / Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Building Supply/Return Temperature	AI	Pipe RTD (2 each)
Chilled Water Supply Temperature	AI	Pipe RTD (1 each)

3.60 CHILLED WATER SYSTEM CONTROL

- A. Temperature sensors located in the building common chilled water supply and return piping and the turbine flow meter located in the building chilled water common supply piping shall, acting through the DDC system, be used to calculate the building BTUH requirements.
- B. During start-up, the lead primary pump shall start. After flow has been indicated from the flow switch for an adjustable time period, the lead chiller shall be activated.
- C. When the load calculated from the temperature sensors and flow meter exceeds the capacity of the lead chiller for an adjustable time period, the second primary pump and chiller shall be activated. When the load calculated from the temperature sensors and flow meter exceeds the capacity of the lead and second chiller for an adjustable time period, the third primary pump and chiller shall be activated.
- D. If the load drops to by 125% of the capacity (adjustable) of one chiller, then the lag chillers will be deactivated. The primary pumps serving the chillers will remain on for 3 minutes (adjustable) and then be deactivated.

- E. Provide time delays between pump starts and stops to allow system to stabilize.
- F. Change lead/lag rotation on a weekly basis.
- G. Interlock chillers to start / stop chilled and condenser water pumps.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Chiller Water Supply Temperature	AI	Pipe RTD (1 each)
Status (Chiller)	DI	Safety Alarm Relay
Pump Start / Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Building Flow	AI	Turbine Flow Meter
Building Supply/Return Water Temp.	AI	Temperature Sensors
Chiller Supply Temperature	AI	Temperature Sensor

3.61 VARIABLE PRIMARY CHILLED WATER SYSTEM CONTROL

- A. Chilled Water Central Plant consists of two air cooled chillers and two variable flow primary chilled water pumps. Each primary chilled water pump is sized for the maximum design flow rate of each chiller. Control shall be as follows:
 - 1. On a call for cooling in the building the lead chiller's chilled water isolation valve shall open slowly. Travel time from fully closed to fully open shall be two minutes. The Indexed lead chilled water pump shall be energized and ramp up to full flow as required corresponding with the isolation valve travel. When internal chiller controls prove chilled water flow, lead chiller shall be energized. Chiller controls shall maintain leaving chilled water supply temperature set point of 42°F (adjustable).
 - 2. Two-system differential pressure sensors shall modulate the energized pump(s) speed controller to maintain the required system pressure in the building.
 - a. Location of the building differential pressure system sensors shall be approved by the engineer and contractor specified in Section 23 05 93.
 - b. Coordinate with the pump motor speed controller specified in another section.
 - 3. On a daily basis change the chilled water pump lead/lag indexing. Daily lead pump indexed to run with the daily lead chiller, daily lag pump indexed to run with the daily lag chiller.
 - 4. Measure the chilled water pressure drop across each chiller evaporator to monitor chiller minimum flow.
 - a. Minimum flow as recommended by the chiller manufacturer.

- b. As the sensed differential pressure falls below the pressure drop associated with the chiller recommended minimum flow rate (3 psi, adj), modulate the variable primary flow by-pass control valve to maintain minimum flow through each chiller.
 - c. Provide control valve and actuator capable of tight close-off against system differential pressure. Size the by-pass valve for the minimum flow of one chiller.
5. Upon a rise in common chilled water supply temperature to 45.5°F (adjustable) for period of 15 minutes (adjustable), the lag chiller and related pump shall be energized.
 - a. Prior to energizing, ramp the lead chilled water pump to 50% of flow (adjustable) and demand limit the lead chiller to 60% capacity (adjustable).
 - b. Open lag chiller's chilled water isolation valve slowly with two minute travel time from fully closed to fully open and ramp up to 50% flow the indexed lag chilled water pump (adjustable). When internal chiller controls prove chilled water and condenser water flow, lag chiller shall be energized. Chiller controls shall maintain leaving chilled water set point of 42°F (adjustable). Release constraints on chiller limits and chilled water pump speed controller to allow system to automatically meet the building requirements.
6. Upon a decreasing load condition, de-energize lag chiller in the opposite order that they were energized.
 - a. Through an interface with the chiller controls, monitor percentage of running load amps (% RLA) of each chiller. When the total of both chiller % RLA drops to 90% (adjustable) of one chiller for 15 minutes (adjustable) de-energize the lag chiller. Allow lag chilled water pump to operate for 5 minutes (adjustable), then de-energize pump and close the chiller's chilled water isolation valve.
7. Alternate the lead/lag chiller on a daily basis.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop (Each chiller)	DO	Control Relay
Chiller LWT Temperature Reset	AO	Chiller Control Module
Chiller % RLA (Each chiller)	AI	Chiller Control Module
Chiller Alarm	AI	Chiller Control Module
Chiller Status	DI	Chiller Control Module
Chiller Isolation Valve (Each Chiller)	AO	Electronic Operator
Chilled Water Supply Temperature (Each chiller)	AI	Pipe RTD
Chilled Water Return Temperature (Each chiller)	AI	Pipe RTD
Chiller Differential Water Press.		

POINT DESCRIPTION	TYPES	DEVICE
(Each chiller)	AI	Pressure Differential Sensor
Pump Start / Stop (Each of two pumps)	DO	Control Relay
Pump VFD (Each of two pumps)	AO	Motor Controller
Pump Status (Each of three pumps)	DI	Current Sensitive Relay
Minimum Flow By-Pass Valve	AO	Electronic Operator
Building Common Supply Water Temperature	AI	Pipe RTD
Building Common Return Water Temperature	AI	Pipe RTD
Building Flow Meter	AI	Turbine Flow Meter
Building Pressure Differential (Two required)	AI	Pressure Sensor

3.62 CONDENSER WATER CONTROL

- A. A sensor located in the condenser water supply shall, through a DDC panel:
1. Modulate the three-way valve located in the condenser water piping.
 2. Enable the variable frequency drive (VFD).
 3. Maintain minimum speed for proper gearbox lubrication and motor cooling.
 4. Control the variable speed of the fan.
 5. Maintain entering water temperature to each condenser as recommended by the chiller manufacture. (85°F adjustable)
- B. Controller sequence:
1. Throttling range: - 20°F.
 2. Set point: - 85°F (adjustable)
 3. At 4° below set point, the condenser water shall be full flow to the tower riser.
 4. At setpoint the VFD is to be enabled at minimum speed.
 5. Upon a continued rise in temperature, the VFD should increase the speed of the cooling tower fan as required to maintain setpoint.
 6. Decrease or increase the speed of the cooling tower fan as required to maintain temperature setpoint.
 7. The VFD should be disabled at 7° below setpoint (adjustable).
- C. Provide full automatic control of the entering condenser water temperature on initial chiller start-up.
- D. Close 3-way control valve to by-pass when pumps are disabled.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop Pump	DO	Control Relay

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop VFD	DO	Control Relay
VFD speed	AO	Electronic output
Tower Bypass Valve	AO	Electronic Operator
Tower Isolation Valve	AO	Electronic Operator
Chiller Isolation Valve	AO	Electronic Operator
Status (Pumps)	DI	Current Sensitive Relay
Status (Tower Fan)	DI	Current Sensitive Relay

3.63 CHILLED WATER SYSTEM CONTROL

- A. The system consists of one air-cooled chiller and with a dedicated chilled water pump.
- B. Start/stop the chilled water system upon a call for cooling in the system.

POINT DESCRIPTION	TYPE	DEVICE
Pump Start/Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Building supply/return Temp.	AI	Pipe RTD (2 each)
Chiller Status	DI	Safety Alarm Relay

HEATING SYSTEM

3.64 HYDRONIC HEATING SYSTEM

- A. The system consists of one heating water boiler, and dedicated pump.
- B. Energize the pump whenever there is a call for heating in the building.
- C. Heating water temperature reset
 - 1. A temperature sensor located in the building heating water supply piping shall:
 - a. Signal the DDC panel.
 - b. Modulate the three-way valve in the boiler water piping to maintain the desired building heating water temperature.
 - 2. A temperature sensor sensing outdoor air shall reset the control point of the DDC inversely with the outside air temperature.
 - a. Maintain 180°F when the outside air temperature is 20°F.

- b. Maintain 140°F when the outside air temperature is 70°F and above.
- D. Enable the boiler throughout the year with an override option to disable the boiler, as Owner requires.
- E. Interlock the boiler circulating pump with the related boiler. Provide a time delay relay off to disperse the heat in the boiler as required by manufacturer. Disable the related pump if boiler fails to produce heating water or boiler goes into alarm.

POINT DESCRIPTION	TYPES	DEVICE
Boiler Enable/Disable	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay
Pump Start/Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Building Supply/Return Temperature	AI	Pipe RTD
Hot Water Mixing Valve	AO	Electronic Operator
Boiler discharge water Temperature	AI	Pipe RTD
Ambient Temperature	AI	Thermistor

3.65 HYDRONIC HEATING SYSTEM

- A. The system consists of two heating water boilers and dedicated pumps. Control of the hot water heating system is as follows:
 - 1. Energize the building hot water heating system whenever there is a call for heating in the building.
 - 2. Energize the boiler(s) and boiler water circulating pump(s) whenever there is a call for heating and based on the following schedule:
 - Outside temperature at 50°F or above - lead boiler only.
 - Outside temperature below 50°F - lead and lag boiler.
 - Return water temperature drops below 140° F lag boiler.
 - 3. Interlock the boiler circulating pump with the related boiler. Provide a time delay relay off to disperse the heat in the boiler as required by manufacturer. Disable the related pump if boiler fails to produce heating water or boiler goes into alarm.
 - 4. A temperature sensor sensing outdoor air temperature shall reset the hot water temperature inversely with the outdoor air temperature using the mixing valve at each boiler.
 - a. Maintain 180°F when the outdoor temperature is 20°F.
 - b. Maintain 140°F when the outdoor temperature s 70°F and above.
 - 5. Provide lead/lag sequencing to alternate lead boiler on a daily basis.
 - 6. Enable the boilers throughout the year with an override option to disable the boilers, as Owner requires.

POINT DESCRIPTION	TYPES	DEVICE
Boiler Enable/Disable	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay
Pump Start/Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Building Supply/Return Temperature	AI	Pipe RTD
Hot Water Mixing Valve	AO	Electronic Operator
Boiler discharge water Temperature	AI	Pipe RTD
Ambient Temperature	AI	Thermistor

3.66 HYDRONIC HEATING SYSTEM

- A. System consists of two heating water boilers and dedicated variable speed pumps. Control of the hot water heating system is as follows:
1. Energize the boiler(s) and boiler water circulating pump(s) whenever there is a call for heating and based on the following schedule:
Outside temperature at 50°F or above - lead boiler only.
Outside temperature below 50°F - lead and lag boiler.
Return water temperature drops below 140° F lag boiler.
 2. A system differential pressure sensor shall sequence the pumps and signal the heating water pump speed controllers.
 - a. Stage the pumps to maintain desired system differential pressure.
 - b. Modulate the pump speed controllers to maintain desired system differential pressure.
 - c. Coordinate with the pump motor speed controller specified in another section.
 - d. Location and quantity of sensors to be approved by Engineer / Section 23 05 93.
 - e. Alternate the lead pump on a daily basis.
 3. A temperature sensor sensing outdoor air temperature shall reset the hot water temperature inversely with the outdoor air temperature using the mixing valve at each boiler.
 - a. Maintain 180°F when the outdoor temperature is 20°F.
 - b. Maintain 140°F when the outdoor temperature is 70°F and above.
 4. Provide lead/lag sequencing to alternate lead boiler on a daily basis.
 5. Enable the boilers throughout the year with an override option to disable the boilers, as Owner requires.
 6. Interlock the boiler circulating pump with the related boiler. Provide a time delay relay off to disperse the heat in the boiler as required by manufacturer. Disable the related pump if boiler fails to produce heating water or boiler goes into alarm.

POINT DESCRIPTION	TYPES	DEVICE
Boiler Enable/Disable	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay
Pump Start/Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
System Differential Pressure	AI	Pressure Sensor
Pump Speed Controller	AO	Motor Controller
Building Supply/Return Temperature	AI	Pipe RTD (2 each)
Hot Water Mixing Valve	AO	Electronic Operator
Boiler Shell Water Temperature	AI	Pipe RTD in boiler shell
Ambient Temperature	AI	Thermistor

3.67 HYDRONIC HOT WATER HEATING SYSTEM

- A. This system consists of two condensing hot water boilers with constant flow primary boiler pumps and variable flow hot water secondary pumps. Control of the hydronic hot water heating system is as follows:
1. Energize the hydronic hot water heating system whenever there is a call for heating in the building.
 - a. Monitor all control valves to determine if a heating requirement exists.
 2. Energize the hybrid sequence controller specified elsewhere.
 - a. The hybrid sequence controller shall control all functions and sequencing of the hot water heating boilers.
 - b. Connect all boilers to the master boiler controller specified elsewhere with communication cable as required.
 3. Hydronic hot water heating system supply temperature reset.
 - a. A temperature sensor sensing outdoor temperature shall provide an input to the hybrid sequence controller to reset the hot water supply temperature.
 - 1) Maintain 130°F supply water temperature whenever the ambient temperature is 20°F and below.
 - 2) Maintain 110°F supply water temperature whenever the ambient temperature is 60°F and above.
 - 3) All reset temperatures shall be adjustable through the BMCS.
 4. Secondary hot water pump control:
 - a. A system differential pressure sensor shall modulate the hot water pump variable frequency drives and stage pumps A and B to maintain system differential pressure.
 - b. This system shall be completely adjustable in the field.

POINT DESCRIPTION	TYPES	DEVICE
Hybrid Sequence Controller	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay (Each Boiler)
Secondary Hot Water Pump Start/Stop/Modulation	AO	Variable Frequency Drive (Each Pump)
Pump Status	DI	Current Sensitive Relay
Building Hot Water Supply/Return Temperature	AI	Pipe RTD
Boiler Discharge Water Temperature	AI	Pipe RTD (Each Boiler)
Ambient Temperature	AI	Thermistor
Boiler Supply Water Reset	AO	Hybrid Sequence Controller

WATER COOLED CHILLERS

3.68 CHILLED WATER SYSTEM CONTROL

- A. Temperature sensors located in the building common chilled water supply and return piping and the turbine flow meter located in the building chilled water common supply piping shall, acting through the DDC system, be used to calculate the building BTUH requirements.
- B. Chiller 1 with its respective pump shall be System 1. Chiller 2 with its respective pump shall be System 2.
- C. During start-up, System 1 primary pump shall start. After flow has been indicated from the flow switch for an adjustable time period, the System 1 chiller shall be activated.
- D. When the load calculated from the temperature sensors and flow meter exceeds the capacity of System 1 for an adjustable time period, the System 2 primary pump and chiller shall be activated.
- E. If the load drops to below half the capacity (adjustable) of one system, then the lag chillers will be deactivated. The primary pumps serving the chillers will remain on for 3 minutes (adjustable) and then be deactivated.
- F. A temperature sensor located in the chiller by-pass piping shall send an alarm to the host computer and shall start the lag chiller after an adjustable time delay, if the temperature in the by-pass is above 3 (adjustable) higher than the temperature in the common supply from the chillers. This indicates the flow is moving from the primary loop to the secondary loop.
- G. Provide time delays between pump starts and stops to allow system to stabilize.

- H. Change lead/lag rotation on a weekly basis.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Chiller Water Supply Temperature	AI	Pipe RTD (1 each)
Status (Chiller)	DI	Safety Alarm Relay
Pump Status	DI	Current Sensitive Relay
Building Flow	AI	Turbine Flow Meter
Building Supply/Return Water Temp.	AI	Temperature Sensors
Bypass Temperature	AI	Temperature Sensor
Common Chiller Supply Temperature	AI	Temperature Sensor
Common Chiller Return Temperature	AI	Temperature Sensor

3.69 CHILLED WATER SYSTEM CONTROL

- A. Sensors, each located in the common chilled water supply and return piping header and the turbine flow meter located in the building return or supply piping header shall, through a DDC controller, provide appropriate building Btuh calculations.
- B. Start the smallest tonnage chiller on a daily basis first as system 1.
- C. When the load calculated from the temperature sensors and flow meter exceeds 90% of the capacity of System #1 for an adjustable time period, the System #2 primary pump and chiller shall be activated. After System #2 has proven to be enabled, disable System #1.
- D. When the load calculated from the temperature sensors and flow meter exceeds 90% of the capacity of System #2 for an adjustable time period, the System #3 primary pump and chiller shall be activated.
- E. When the load calculated from the temperature sensors and flow meter exceeds 90% of the capacity of System #2 and #3 for an adjustable time period, the System #1 primary pump and chiller shall be activated.
- F. If the load drops to below 75% of the capacity (adjustable) of one system, then the lag chillers will be deactivated.
- G. A temperature sensor located in the chiller by-pass piping shall send an alarm to the DDC controller and shall start the lag chiller after an adjustable time delay, if the temperature in the by-pass is above 3 (adjustable) higher than the temperature in the common supply

from the chillers. This indicates the flow is moving from the primary loop to the secondary loop.

- H. Provide time delays between pump starts and stops to allow system to stabilize.
- I. Provide lead/lag sequencing to alternate lead chiller of System #2 and #3 on a daily basis, based on total run time.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay (each chiller)
Common Chiller Water Supply	AI	Pipe RTD
Common Chiller Water Return	AI	Pipe RTD
Status (Chiller)	DI	Safety Alarm Relay (each chiller)
Condenser water supply Temp.	AI	Pipe RTD (each chiller) Temperature
Chilled Water Supply	AI	Pipe RTD (each chiller) Temperature
Building Flow	AI	Turbine Flow Meter
Bypass Temperature	AI	Pipe RTD

3.70 CHILLED WATER SYSTEM CONTROL (MAIN CENTRAL PLANT)

- A. The system consists of three water cooled chillers and three dedicated primary chilled water pumps.
- B. Temperature sensors located in the building common chilled water supply and return piping and the turbine flow meter located in the building chilled water common supply piping shall, acting through the DDC system, be used to calculate the building BTUH requirements.
- C. During start-up, one primary pump shall start. After flow has been indicated from the flow switch for an adjustable time period, the chiller shall be activated.
- D. When the load calculated from the temperature sensors and flow meter exceeds the capacity of one chiller for an adjustable time period, the second primary pump and chiller shall be activated.
- E. If the load drops to below half the capacity (adjustable) of one chiller, then the lag chiller will be deactivated. The primary pump serving the chiller will remain on for 3 minutes (adjustable) and then be deactivated.
- F. A temperature sensor located in the chiller by-pass piping shall send an alarm to the host computer and shall start the lag chiller after an adjustable time delay, if the temperature in

the by-pass is above 3 degrees (adjustable) higher than the temperature in the common supply from the chillers. This indicates the flow is moving from the primary loop to the secondary loop.

- G. Provide time delays between pump starts and stops to allow system to stabilize.
- H. Change lead/lag rotation on a weekly basis.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Chilled Water Supply Temperature	AI	Pipe RTD (1 each)
Status (Chiller)	DI	Safety Alarm Relay
Pump Status	DI	Current Sensitive Relay
Building Flow	AI	Turbine Flow Meter
Building Supply/Return Water Temp.	AI	Temperature Sensors
Bypass Temperature	AI	Temperature Sensor

CONDENSER WATER CONTROL

3.71 CONDENSER WATER CONTROL

- A. A sensor located in the condenser water supply shall, through a DDC panel:
 - 1. Modulate the three-way valve located in the condenser water piping.
 - 2. When the three-way control valve is in the full cooling position with all the water flowing over the tower and no water being by-passed enable the tower fan.
 - 3. Cycle the tower fan to maintain water temperature entering each condenser at 85°F.
 - 4. As the temperature decreases cycle the fan to the off condition and modulate the three-way control valve towards the by-pass position.
- B. Controller sequence:
 - 1. Throttling range: - 20°F.
 - 2. Set point: - 85°F (adjustable)
 - 3. At set point the condenser water shall be full flow to the tower riser.
 - 4. Maximum condenser water supply: - 85°F.
 - 5. Energize the tower fan at 82°F.
- C. Provide wiring for vibration switch, with manual reset, to de-energize the fan in the event of a sensed malfunction.
 - 1. Set limits as recommended by the tower manufacturer.
 - 2. Vibration switch specified to be provided in Section 23 65 40.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop Pump	DO	Control Relay
Start/Stop Tower Fan	DO	Control Relay
Tower Bypass Valve	AO	Electronic Operator
Status (Pumps)	DI	Current Sensitive Relay
Status (Tower Fan)	DI	Current Sensitive Relay

PUMPING SYSTEM CONTROL

3.72 SECONDARY CHILLED WATER PUMPING SYSTEM CONTROL

- A. The system consists of **EDIT three** variable speed secondary chilled water pumps controlled as follows:
1. The chilled water pumping system will be energized whenever there is a call for cooling in the building system.
 2. A system differential pressure sensor shall sequence the pumps and signal the chilled water pump speed controllers.
 - a. Stage the pumps to maintain desired system differential pressure.
 - b. Modulate the pump speed controllers to maintain desired system differential pressure.
 - c. Coordinate with the pump motor speed controller specified in another section.
 3. Alternate the lead pump on a daily basis.
 4. Location and quantity of sensors to be approved by Engineer.

POINT DESCRIPTION	TYPES	DEVICE
Pump Start/Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
System Differential Pressure	AI	Pressure Sensor
Pump Speed Controller	AO	Motor Controller

3.73 CHILLED WATER SYSTEM BYPASS

- A. The system consists of chilled water system pressure sensors and a system bypass valve controlled as follows:
1. A system differential pressure sensor shall modulate the chilled water bypass valve to maintain system pressure.

POINT DESCRIPTION	TYPES	DEVICE
System Differential Pressure	AI	Pressure Sensor
Bypass Valve	AO	Electronic Operator

3.74 MISCELLANEOUS

- A. Central Plant Ventilation: The ventilation system consists of two exhaust fans and motorized dampers with louvers for make-up air. The fans shall be activated by a thermostat, with an emergency pushbutton on the exterior of the central plant at the entrance, or from a signal from the oxygen depletion sensor. Anytime the fans are activated the dampers on the louvers shall open. When the fans are activated by the thermostat, the fans shall be sequenced so that the first one operates at 75°F (adjustable) and the second one operates at 85°F (adjustable).

3.75 LABORATORY FUME HOOD

- A. Provide start/stop pushbutton with pilot light for fume hood exhaust fan. Locate pushbutton on hood.

3.76 EMERGENCY PURGE

- A. Provide start/stop pushbutton with pilot light for laboratory emergency purge. Locate pushbutton where indicated on Drawings.

3.77 DISHWASHER EXHAUST

- A. Interlock exhaust fan to operate when dishwasher is operating. Provide 5 minute (adjustable) run time for fan after dishwasher stops.

3.78 CHEMICAL TREATMENT SYSTEM

- A. Monitor water treatment power circuit and alarm contacts from water treatment controllers. Provide with cooling tower systems only.

3.79 EMERGENCY VENTILATION SYSTEM

- A. Provide a refrigerant monitor, an emergency ventilation button, and an emergency machinery button for control in the central plant on inside & outside each of each door. Upon alarm either through the sensor or by manually pushing the emergency ventilation button, the emergency exhaust fan shall be activated. Upon alarm, either through the sensor, or by manually pushing the emergency machinery button, all the mechanical equipment, i.e. chillers and pumps, shall be deactivated. A temperature sensor located in the room shall enable exhaust fan if the temperature rises above 85F. Provide a visual and audible device. Alarm levels of refrigerant concentrations are provided in the Code. Label buttons per Code. Label each audible and visual device as specified. Provide a sign at each entrance to central plant to indicate information about system. Provide two (SCUBU) units as required by code on inside and outside of central plant.

POINT DESCRIPTION	TYPES	DEVICE
Refrigerant Sensor	DI	Control Panel
Emergency Ventilation Button	DI	Button
Fan Start/Stop	DO	Control Relay
System Start/Stop	DO	Control Relay
Emergency Machine Button	DI	Button

3.80 EMERGENCY VENTILATION SYSTEM

- A. Provide a refrigerant monitor, an emergency ventilation button, and an emergency machinery button for control in the central plant on inside & outside each of doors. **A two-speed exhaust fan shall be provided for ventilation. The fan shall operate in low speed continuously.** Upon alarm either through the sensor or by manually pushing the emergency ventilation button, the emergency exhaust fan shall be go to high speed. Upon alarm, either through the sensor, or by manually pushing the emergency machinery button, all the mechanical equipment, i.e. chillers and pumps, shall be deactivated. A temperature sensor located in the room shall switch the fan to high speed if the temperature rises above 85°F. Provide a visual and audible device. Label buttons per Code. Buttons shall be break glass type. Alarm levels of refrigerant concentrations are provided in the Code. Label buttons per Code. Refrigerant levels shall be available at the BMCS. Provide two (SCUBU) units as required by code on inside and outside of central plant. Provide a sign at each entrance to central plant to indicate information about system.

POINT DESCRIPTION	TYPES	DEVICE
Refrigerant Sensor	DI	Control Panel
Emergency Ventilation Button	DI	Button
Fan Speed	DO	Control Relay
System Start/Stop	DO	Control Relay
Emergency Machine Button	DI	Button
Temperature Sensor	AI	Thermister

3.81 SWIMMING POOL PACKAGED UNIT

- A. This unit is a packaged unit with controls included with the unit. The unit dehumidifies, cools, and heats the natatorium. The unit shall be started through the BMCS. The BMCS shall monitor the indoor temperature and relative humidity conditions and the display the operating mode of the packaged unit. Interlock the swimming pool heating water pump

(furnished by the Pool Contractor) with the swimming pool unit. Install remote controls, outside air sensors, space sensors provided with by pool unit manufacturer. Provide interlock wiring between remote condenser and swimming pool unit. Coordinate locations and wiring with manufacturer.

POINT DESCRIPTION	TYPES	DEVICE
Start / Stop	DO	Control Relay
Status	DI	Current Sensitive Relay
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Space Humidity Sensor
Swimming Pool Pump Status	DI	Current Sensitive Relay
Swimming Pool Pump	DO	Control Relay

3.82 START-UP AND POINT VERIFICATION

- A. Final startup and point verification shall include the following information.
 1. Field panel checkout:
 - a. Verify enclosure is not mounted on vibrating surface.
 - b. Verify class I and class II wiring is separated within enclosure.
 - c. Check for shorts/grounds/induced voltages/proper voltages.
 - d. Verify proper point terminations in accordance with as-builts.
 - e. Verify that all modules are in proper place and addressed.
 - f. Verify proper power voltage.
 - g. Load database and programming.
 - h. Startup the panel.
 - i. Point and device checkout.
 2. Analog input point checkout:
 - a. Verify the correct wiring terminations per the design documentation package, at the field panel. Verify that all wiring and terminations are neat and dressed.
 - b. Verify the point address by checking that the analog input instrument is wired to the correct piece of field equipment. Do this by altering the environment at the sensing element or by disconnecting one of the wires at the sensor, and verifying that the reading at the field panel has reacted to this change.
 - c. Verify the point database to be correct, (i.e., alarmability, alarm limits, slope/intercept, engineering units, etc.). Verify that the correct change of value (COV) limit has been defined.
 - d. Verify the sensor has the correct range and input signal. (i.e., 20-120°F, 4 - 20 ma). Verify that the device is mounted in the correct location and is wired and installed correctly per the design documentation package.
 - e. Set-up and/or calibrate any associated equipment (i.e., panel LCD meters, loop isolators, etc.). Verify that these auxiliary devices are mounted in the correct location and are wired and installed correctly per the design documentation package.
 - f. Verify the correct reading at the field panel using appropriate MMI

- devices. Verify that any associated LCD panel meters indicate the correct measured value.
3. Digital input point checkout:
 - a. Verify the device is correctly wired and terminated as shown in the design documentation package. Verify that all wiring and terminations are neat and properly secured.
 - b. Verify the point address by verifying that the digital input is correctly terminated at the controlled piece of equipment.
 - c. Verify the point database is correct (i.e., point name, address, alarmability, etc.).
 - d. Set-up and/or calibrate the associated equipment, i.e. smoke detector, high/low temp detector, high/low static switch, flow switch, end switch, current relay, pressure switch, etc. is mounted in the correct location, and is wired and installed correctly per the control system installation drawings.
 - e. With the controlled equipment running or energized as described in the digital output checkout procedures, verify the correct operation of the digital input point and associated equipment by putting the digital input monitored equipment into its two states. Verify that the proof or status point indicates the correct value at the operator's terminal and that the status led is giving the proper indication in each mode of operation (on/off).
 4. Digital output point checkout:
 - a. Verify that device is correctly wired and terminated as shown in the design documentation package.
 - b. Verify that the correct voltage is utilized in the circuit.
 - c. Verify the point database to be correct (i.e. point name, address, etc.).
 - d. Check and verify that the end device responds appropriately to the digital output(s).
 - e. After verifying the set-up and operation of any associated digital input/proof points, check and verify correct operation of the logical point and associated equipment by commanding the point to all possible states (i.e. off, on, fast, slow, auto, etc.). Verify that the defined proof delay is adequate for all modes of operation.
 - f. If any interlocked equipment exists that has independent hand-off-auto or auxiliary control wiring, verify correct operation of same. Also check that any interlocked equipment such as EP switches for damper operation or exhaust and return fans are wired correctly and operate correctly.
 - g. Verify that the controlled piece or pieces of equipment cannot be caused to change state via the digital output if an associated hand-off-auto switch is in the hand/on or hand/off mode of operation, unless specified as a fireman's override point etc.
 5. Analog output point checkout:
 - a. Verify the correct wiring or piping terminations per the design documentation package, at the field panel. Verify that all wiring and piping terminations are neat and dressed.
 - b. Insure that the correct output device(s) are installed per the Control System Installation Drawings. (i.e., I/P or P/I transducers, transformers, power supply, etc.). Verify that these devices are installed, wired and piped correctly. Verify that any configuration jumpers are in the proper settings for the required application. Verify related transformers are fused in accordance with installation drawings.
 - c. Verify the point database to be correct. Verify that the correct COV limit has been defined.

- d. Verify the point address by checking that the analog output is wired and/or piped to the correct output transducer and/or equipment.
- e. Verify that the controlled device is calibrated (i.e., 3-8PSI valve, 8-13 PSI damper motor, 4-20 ma variable frequency drive, etc.) and is in the correct location, and is wired or piped and installed correctly per the design documentation package. If the controlled device is not calibrated, then a three-point (high, low and mid-point) calibration procedure must take place. Verify proper operation of the end device. When calibration has been verified, ensure that installation drawings, point database, and PPCL have been updated.
- f. Set-up and or calibrate any associated equipment, (i.e., panel LCD meters, loop isolators, pneumatic gauges, etc.). Also verify that these auxiliary devices are mounted in the correct location, and are wired or piped and installed correctly per the design documentation package.
- g. After verifying the set-up and operation of any associated equipment check for the correct operation of the logical point and associated equipment by commanding the analog output to the top and bottom of its range. Verify that the control device(s) responded appropriately as indicated by the design documentation package. Check to insure that all network terminals, host console devices, etc. can also command these outputs.
- h. Check that all pneumatic gauges, pilot positioners and LCD panel meters indicate the correct values.
- 6. Terminal equipment controller checkout:
 - a. Load program database
 - b. Enable programs
 - c. Verify sequence of operations
- 7. Programming checkout:
 - a. Provide checkout for each system and sequence of operation.
 - b. The following are sample sequence of operations tests. The intent of these procedures is to provide a plan of action to verify system operations via block checks of the project specific sequence of operations. The procedures may be used in this format, or one procedure to a page should more detail be required. The procedures outlined below should be verified for accuracy, and may be modified to meet your specific requirements.
 - c. Description of Test: AHU Alarm Checkout. Verify AHU-1 discharge air temperature alarming is operational and is received at the designated terminal.
 - d. Input to Trigger Test: Change discharge temperature high alarm limit through software to a value below the current discharge temperature (discharge temperature - 10°F).
 - e. Expected Outcome: A high temperature alarm will be received per the Alarm Definition Report at its designated terminal.
 - f. Provide signoff sheet with indication for test Pass, Fail, Date of test and Initials for signoff.
- 8. Workstation checkout:
 - a. Verify the operation of all trunk interface equipment.
 - b. Verify all workstation software, including options, based upon the installation instructions for the PC.
 - c. Perform software backup (site, options, etc.)
 - d. Complete workstation configuration report for owner signoff.
 - e. Provide verification that all graphics have been created, as required by project bid documents.

3.83 TESTING AND ACCEPTANCE

A. General:

1. After completion of installation and start-up procedures, commence the specified 3-phase verification and testing sequence leading to final acceptance.
 - a. Follow in the order specified.
 - b. Each testing phase shall be satisfactorily completed before entering the next phase.
2. Prior to entering each phase of the sequence, submit for approval, a written agenda describing in detail the procedure to be followed to meet the requirements for each specified verification, test or demonstration.
3. Submit for approval, a sample of the form on which the test will be reported.
 - a. Identify project.
 - b. Provide a list of all points, arrange in numerical order of point addresses.
 - 1) Show point descriptor and location of each.
 - 2) Indicate DDC panel that processes each point.
 - 3) Use the list as a basis for the specified report form.
 - c. Signatures of participants and observers.
 - d. Results.
 - e. Description of adjustment or corrections of points in error.
 - f. Date.
4. Provide schedule of tests. Estimate dates of significant events.
5. Test, calibrate and adjust each point in the system as specified.
6. Provide documentation of all tests and verifications as specified.
7. Provide trend reports indicating proper control of all points for an extended period of time.

B. Phase 1 - Testing, Calibrating, and Adjusting:

1. Operate each analog point in the entire system.
 - a. At a point in the upper quarter of its range.
 - b. At a point in the lower quarter of its range.
 - c. At its operating point.
2. Provide personnel and diagnostic instruments at both the central and remote locations.
3. Provide testing stimulants for alarms.
4. Use digital meters of double the accuracy of the instruments being calibrated.
5. Provide an approved test device for simulating high and low temperatures.
6. When the function is performed, read values at the central control and observe the actual function at the field instrument.
7. Exercise each binary point and observe indication at console and simultaneously observe operation in the field.
8. Submit an operation report for each point in the system, in approved format, and describe any corrective or adjusting action taken.
9. Test all power transducers with a Dranetz Power Analyzer.

C. Phase 2 - Equipment and Point Verification:

1. Verify calibration or function of each point.
 - a. Verify analog points at operating value.
 - b. Record on specified form.
 - c. Make approved adjustments to out of tolerance points.

- 1) Identify these points for ready reference.
2. After verification procedure is completed:
 - a. Verify corrected points.
 - b. Record on specified form.
 - c. Points requiring correction.
 - 1) Replace sensor or actuator if electrical measurements indicated components are out of specified tolerance.
- D. Phase 3 - Software Verification:
 1. Submit agenda and report format for software demonstrations.
 2. Demonstrate to the Owner and the Engineer that all software programs and automatic control sequences function as specified.
 3. Demonstrate compliance with response time specifications.
 - a. Simulate normal heavy load conditions.
 - b. Initiate at least ten successive occurrences on normal heavy load conditions as specified, and measure response time of typical alarms and status changes.
 04. Provide written documentation of demonstration, signed by representatives of the Contractor and Engineer.
- E. Provide the following reports to Engineer at final completion of all Testing:
 1. List of all points.
 2. List of all points currently in alarm.
 3. List of all disabled points.
 4. List of all points in over-ride status.
 5. List of all points currently locked out.
 6. List of user accounts and access levels.
 7. List all weekly schedules.
 8. List of holiday programming schedules.
 9. List of limits and deadbands.
 10. System diagnostics reports including, list of DDC panels on line and communicating, status of all DDC terminal units device points.
 11. List of programs.
 12. Provide trend data reports to ensure proper operation and sequence control of BMCS.
- F. Substantial Completion of the BMCS will not occur until completion and acceptance of all testing and acceptance procedures.

3.84 TRAINING

- A. The contractor shall provide factory-trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.
- B. Provide 40 hours of training for Owner's designated operating personnel. Training shall include:

Explanation of drawings, operations and maintenance manuals

Walk-through of the job to locate control components
Operator workstation and peripherals
DDC controller and ASC operation/function
Operator control functions including graphic generation and field panel programming
Operation of portable operator's terminal
Explanation of adjustment, calibration and replacement procedures
Student binder with training modules

- C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor.

3.85 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule.
 2. Authorized to accept and execute orders or instructions from General Contractor, Owner / Architect & Engineer.
 3. Attend project meetings as necessary to avoid conflict and delays.
 4. Make necessary field decisions relating to this section.
 5. Coordination / Single point contact.
 6. Have Internet access for project management.

END OF SECTION 23 09 33

SECTION 23 09 34
COORDINATION OF BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Building Management and control System for the facility shall be furnished and installed under a separate contract. The items listed below shall be furnished and/or installed by this contractor.

PART 2 - PRODUCTS

- A. Products provided by the Building Management and Control System (BMCS) Contractor.
 - 1. Control Valves
 - 2. Dampers
 - 3. Wells for sensors installed in piping system
 - 4. Flow Meters

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate with the Building Management and Control System (BMCS) Contractor.
 - 1. Provide project-scheduling information to the BMCS Contractor to allow ample time for purchase of equipment and devices.
 - 2. Schedule periodic project meetings to review progress and coordination issues.
 - 3. Submit a written report, to the Architect/Engineer, on a monthly basis stating status of coordination effort.
- B. The BMCS contractor will submit shop drawings to this contractor for review and coordination processing.

3.02 INSTALLATION

- A. This Contractor will be responsible for the following:
 - 1. Installation of control valves for HVAC equipment.
 - 2. Installation of dampers for HVAC equipment.
 - 3. Installation of temperature sensor wells in piping.
 - 4. Installation of pressure taps in piping system.
 - 5. Installation of flow meter taps in piping system.
- B. Install the above material under the direction of the Building Management and Control System (BMCS) Contractor.

END OF SECTION 23 09 34

SECTION 23 20 00
HVAC PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 23 - Mechanical.

1.02 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Earthwork.
 - 2. Valves, Strainers and Vents.
 - 3. Vibration Isolation.
 - 4. Insulation.
 - 5. Other Piping Sections

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.02 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.

1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
 2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
 3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. Mechanical Joints: Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
 2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
 3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
 4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

2.03 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe material of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.04 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller: For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.05 GASKETS

- A. High Temperature Piping: Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.

- B. Other Piping: Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.06 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.07 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

PART 3 - EXECUTION

3.01 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufactured, for maintenance.
- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.

3.02 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing

piping sections, fittings, valves or equipment.

- F. Bevel ends of ferrous pipe.

3.03 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.04 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging. Review structural drawings for additional information.
- B. Provide supports both sides and within 12" of each horizontal elbow for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On chilled water pipe supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion. Use hangers with 1-1/2" minimum vertical adjustment.
- F. Use electro-galvanized or zinc plated beam clamps if acceptable to the structural engineer, threaded rods, nuts, washers and hangers. All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. Use only on beams as directed by the Structural Engineer.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Provide hangers within 3' of pipe length from all coil connections.
- I. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Ft.	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.05 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanized members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.
- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.06 PIPE SUPPORTS ON ROOF

- A. Support condensate drain pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.07 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.08 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.09 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide

continuous insulation.

- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate. Flush the chilled and hot water systems utilizing the filter feeders.
- B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has

been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.

- C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until “potable water clear” and particles larger than 5 microns are removed.
- D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be equal to Nalco 2578 prepping compound. Insert anti-foam compound as necessary. Circulate for 48 hours or as recommended by the manufacture. Dispose of water in approved manner. Flush system and replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects.
- G. Phase Three: Final flushing and rinsing: Flush and rinse until “potable water clear” and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
- H. Submit status reports upon completion of each phase of work on each system.
- I. Special requirements, if any, are specified in the sections on each type of piping or in the section on Water Treatment Systems.

3.13 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of

markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION 23 20 00

SECTION 23 20 01
NON-PENETRATING PORTABLE ROOFTOP SUPPORTS AND WALKWAYS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Portable, non-penetrating, rooftop support systems for:
 - 1. Piping
 - 2. Ducting
 - 3. HVAC equipment
 - 4. Crossovers

1.02 RELATED WORK

- A. Division 7 – Roofing
- B. Section 23 07 13 – External Duct Insulation
- C. Section 23 07 19 – Mechanical Piping Insulation

1.03 REFERENCES

- A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM D 1929 - Standard Test Method for Determining Ignition Temperature of Plastics.
- D. MSS SP-58 - Pipe Hangers and Supports -- Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry.
- E. MSS SP-69 - Pipe Hangers and Supports -- Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry.

1.04 SYSTEM DESCRIPTION

- A. Support piping on roof with an engineered, prefabricated system designed for installation without roof penetrations, flashings, or damage to the roofing material. The system shall consist of bases, made of high density polypropylene plastics with UV Protection, a HDG structural steel frame, and suitable pipe hangers for the application. Nuts, threaded rods and washers shall be galvanized to prevent rust.
- B. Support elevated walkway systems routed across the roof with an engineered, prefabricated walkway system, designed for installation without roof penetrations, flashings, or damage to the roofing material. The system shall consist of bases made of high density polypropylene plastics with UV Protection, a galvanized structural steel frame, walkway planking, and handrail if required. Nuts, threaded rods and washers shall be HDG, spring nuts, and bolts for spring nuts will be electro-plated. System shall be custom designed to fit the load requirements.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00, 23 05 00
- B. Product Data: Submit for all products proposed for use, describing physical characteristics and method of installation.
- C. Shop Drawings: Show installation layout, sizes of units, and details of installation.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing pipe support systems, with a minimum of eight years of documented experience.
- B. Installer Qualifications: Company approved by manufacturer with not less than five years of experience in installation of piping support systems.
- C. References: Submit list of references comprising not less than 10 installations that have been in use for a minimum of five years. Include contact name and phone numbers for each reference.
- D. Pre-Installation Meeting: After approval of submittals, but before beginning installation, conduct a meeting at the project site attended by the Architect, Contractor, installers of roofing, and mechanical and electrical piping, to be installed on pipe support systems.
 - 1. Purpose of meeting is to describe in detail the installation process and to establish agreement, coordination, and responsibilities.
 - 2. Prepare detailed meeting report and distribute copies to the Architect and all attendees.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to project site in manufacturer's original packaging, marked with manufacturer's name, product model names and catalog numbers, identification numbers, and other related information.
- B. Store materials under cover until needed for installation.

1.08 WARRANTY

- A. Warranty: 5 year parts and labor.

1.09 EXISTING / NEW ROOF WARRANTY

- A. The installation shall be acceptable to the roofing manufacturer.
- B. Contractor shall provide a written guarantee that the existing 20 year guarantee by the roofing manufacturer, Johns Manville, will be preserved. Contractor shall submit the crossover walkway system and the shop drawings for roofing penetration at steel supports for seismic bracing, flashing details, etc. for the manufacturer's approval and confirmation that the existing guarantee will be preserved and all roofing modifications under this contract will be added into the Roofing Manufacturer's Guarantee. Contractor

shall not proceed with any work at the roof area until such written confirmation is received from the roofing manufacturer and submitted to the satisfaction of the Project Manager.

- C. Contractor shall take necessary precautions and provide protection to existing roofing membrane, ducts, pipes, equipment, existing structure and finishes. Any accidental damage to the roofing membrane shall be report to the Project Manager and the roofing manufacturer immediately. The damage shall be repaired in a timely manner by the contractor by the roofing manufacturer's requirements for repair and the repair work shall be approved by the manufacturer to maintain the guarantee.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Portable Pipe Hangers, Inc.
- B. MIRO Industries
- C. Advanced Support Systems

2.02 APPLICATIONS

- A. Support pipes, and ductwork a minimum of 24 inches above roof surface.
 - 1. Support Spacing: 10 ft. MAXIMUM.
 - 2. For Multiple Lines: Portable Pipe Hanger Model number PSE custom or approved equal.
 - 3. For Ductwork: Portable Pipe Hanger Model number PPH-D – Goal Post style or approved equal
 - 3. For Ductwork: Portable Pipe Hanger Model number PPH-D – Enclosed style or approved equal.
 - 4. Accessories for PSE Custom and Other Applications when required.
 - a. On Sloped Roof Surfaces, where slope exceeds 1/4 inch per foot provide base with swivel for slope adjustment.
 - b. Un-insulated Piping: Roller support or clevis hanger.
 - c. Insulated Piping: Clevis hanger supported from horizontal channel with Insulation Protection Shield.
 - d. Bracing required when using base with swivel; when pipe exceeds 24 inches above roof, or when thermal expansion of pipe is great.
- B. Walkway, Crossover & Equipment Platform Access:
 - 1. Bases High Density Polypropylene plastics with additives for UV protection.
 - 2 Substructure: 12 gauge back-to-back channel G-1012A, or approved equal supported directly from the bases.
 - 3 Grating: Mill-galvanized carbon steel in accordance with ASTM A525:
 - a. Gauge 14-ga. steel
 - b. Gauge 18-ga. steel
 - c. Section Width: 12 inches standard
 - d. Section Width: 9 inches
 - e. Section Width: 6 inches
 - f. Channel Height: 1 inch
 - g. Channel Height: 2 inches standard

- h. Flange Options: FM
- i. Flange Options: MM
- j. Surface Condition: MG-traction grip
- k. Surface Condition: MS-smooth
- 4. Handrail: 12 gauge, 1-5/8 inch channel G-5812, or approved equal.
- 5. All substructures and handrails shall be galvanized steel. Spring nuts, and bolts for spring nuts will be electro-plated.

2.03 MATERIALS

- A. Portable Support System: Engineered, portable system specifically designed for installation without the need for roof penetrations, or flashings, and without causing damage to the roofing membrane.
 - 1. Design system using high density, high impact polypropylene bases with carbon black, anti-oxidants for UV protection, and steel framing of 1-5/8 inch B22TH or 1-7/8 inch BTS22TH for support.
 - 2. Custom design system to fit piping, conduits, equipment, or walkways to be installed and actual conditions of service and loading.
 - 3. Piping Supports: Provide suitable hangers and supports.
 - 4. Duct and Equipment Supports: Factory fabricated to support exact duct sizes and equipment to be installed.
 - 5. Walkways and Platforms: Provide galvanized slotted metal grating, in configurations as indicated, and tubular handrails where indicated.
- B. Bases: Injection molded high density, high impact polypropylene with UV-inhibitors and anti-oxidants.
- C. Steel Framing:
 - 1. Channel Types: 1-5/8 inch B22TH or 1-7/8 inch BTS22H, as required for loading conditions.
 - 2. Thickness: 12 gage.
 - 3. Form: Roll-formed 3-sided or tubular channel, perforated with 9/16 inch holes at 1-7/8 inch centers on three sides.
 - 4. Finish: Hot dip galvanize in accordance with ASTM A 123 after fabrication, free of roughness, whiskers, unsightly spangles, icicles, runs, barbs, sags, droplets, and other surface blemishes.
 - 5. Do not use tubing or tube steel.
- D. Stainless Steel Framing:
 - 1. Channel Types: 1-5/8 inch or 1-7/8 inch as required for loading conditions.
 - 2. Thickness: 12 gage.
 - 3. Form: Roll-formed 3-sided or tubular channel.
 - 4. Finish: Mill finish.
 - 5. Do not use tubing or tube steel.
- E. Pipe Supports and Hangers:
 - 1. Fabricated of carbon steel where framing is carbon steel; fabricated of stainless steel where framing is stainless steel; finished same as framing.
 - 2. Sizes 2-1/2 inch (63 mm) and smaller: Single roller supports for piping subject to expansion and contraction; 3-sided channels and pipe clamps.
 - 3. Sizes 3 inch and larger: Rollers or clevis hangers to allow for expansion and contraction without movement of the bases or framing.

- F. Accessories: Clamps, bolts, nuts, washers, and other devices as required for a complete system.
 - 1. Carbon Steel: Hot-dip galvanized in accordance with ASTM A 153/A 153M.
 - 1. Stainless Steel: Mill finish.
 - 2. For mechanical fastening to deck: On wood and steel decks, use bolts with steel plate to attach to deck; on concrete decks use threaded rods and adhesive anchors, with rod embedded at least 1-3/4" into concrete.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that roofing system is complete and that roof surfaces are smooth, flat, and ready to receive work of this section.
- B. Verify that roof surface temperature is at minimum 60°F (15.5°C) for proper adhesive performance.

3.02 PREPARATION

- A. Clean surfaces of roof in areas to receive portable support bases.
 - 1. Sweep loose gravel from gravel surfaced roofs.
 - 2. Remove dirt, dust, oils, and other foreign materials.
- B. Use care in handling portable support system components during installation, to avoid damage to roofing, flashing, equipment, or related materials.

3.03 INSTALLATION

- A. Pipe, Duct, and Equipment Support Systems
 - 1. Locate bases and support framing as indicated on shop drawings and as specified herein. Provide complete and adequate support of all piping, ducting, whether or not all required devices are shown.
 - 2. The use of wood for supporting piping is not permitted.
 - 3. Provide support spacing so deflection of piping does not exceed 1/240 of span.
 - 4. Install framing at spacing indicated, but in no case at greater than 10 feet on center.
 - 5. Accurately locate and align bases.
 - a. Consult manufacturer of existing or new roofing system as to the type of isolation pads required between the roof and base.
 - b. Set isolation pads in adhesive, if required by manufacturer's instructions.
 - c. Place bases on isolation pads.
 - d. Adhere or mechanically attach, if required by code.
 - e. Where applicable, replace gravel around bases.
 - 6. Set framing posts into bases and assemble framing structure as indicated.
 - 7. Use galvanized fasteners for galvanized framing and stainless steel fasteners for stainless steel framing.
 - 8. Provide piping cross over where piping blocks access to other side.
- B. Duct Support Systems

1. Locate bases and support framing as indicated on drawings and as specified herein. Provide complete and adequate support of all piping, ducting, and conduit, whether or not all required devices are shown.
 2. Accurately locate and align bases.
 - a. Consult manufacturer of existing or new roofing system as to the type of isolation pads required between the roof and base.
 - b. Set isolation pads in adhesive, if required by manufacturer's instructions.
 - c. Place bases on isolation pads.
 - d. Adhere or mechanically attach, if required by code.
 - e. Where applicable, replace gravel around bases.
 3. Place pre-assembled support onto bases, attaching framing post to base bracket with 1/2 inch bolts provided, and adjust as needed. Support shall be adjustable to maintain existing elevation and slope.
 4. Use galvanized fasteners for galvanized framing and stainless steel fasteners for stainless steel framing.
- C. Walkway, Crossover & Equipment Platform Access
1. Install substructures at spacing indicated, but not greater than 5 feet on center.
 2. Locate bases and support framing as indicated on drawings and as specified herein. Provide complete and adequate support of all structures.
 3. Accurately locate and align bases.
 - a. Consult manufacturer of existing or new roofing system as to the type of isolation pads required between the roof and base.
 - b. Set isolation pads in adhesive, if required by manufacturer's instructions.
 - c. Place bases on isolation pads.
 - d. Adhere or mechanically attach, if required by code.
 - e. Where applicable, replace gravel around bases.
 4. Set legs of substructures into bases as indicated.
 5. Use galvanized fasteners for galvanized framing and stainless steel fasteners for stainless steel framing.
 6. Layout and fasten planking to substructures.
 7. Where handrails are required, install as follows:
 - a. Install intermediate rails without tightening.
 - b. Make minor adjustments as needed, such as spacing of substructures to accommodate intermediate handrails, and install hold-downs.
 - c. Secure intermediate handrails and install top handrails.

3.04 FIELD QUALITY CONTROL

- A. Provide a factory-trained representative of the manufacturer to visit the site while the work is in progress to assure that the installation conforms to the manufacturer's design and installation requirements.

3.05 CLEANING AND PROTECTION

- A. Remove all packaging, unused fasteners, adhesive and other installation materials from the project site.
- B. Remove adhesive from exposed surfaces of supports and bases, and leave the work area in clean condition.

- C. Provide protection as required, leaving the work area in undamaged condition at the time of completion of work.

END OF SECTION 23 20 01

SECTION 23 21 23
HVAC PUMPS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. General characteristics for pumps specified in Division 23 - Mechanical.

1.02 RELATED WORK

Requirements for pumps are specified in other sections of Division 23 - Mechanical, including the following:

- A. Division 23 Mechanical - Electrical Provisions of Mechanical Work.

1.03 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.
- J. Pumps shall be suitable for parallel operation. Where pumps are operated in parallel, individual pumps shall be capable of stable operation with only one pump operating in the system. Submit pump curves with single and multiple pumps operating on system curve for approval.

1.04 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not

overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.

- B. The head capacities indicated in the schedules are listed for bidding purposes only. Calculate the operating head at each pump; take into consideration the actual routing of the various lines, pressure drops in heat exchangers and coils, exact lengths of pipe, fittings, etc. Submit these calculations, together with copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

1.05 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. When multiple pumps are operating in parallel, show pump curves for one pump running, two pumps running, and so on. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.01 HORIZONTAL PUMPS

- A. Pump Construction:
1. Cast iron, designed for 175 psi working pressure
 2. Bronze case wear rings
 3. Grease lubricated ball bearings selected for an average life of 200,000 hours; pressure grease fittings
 4. Flexible coupled
 5. Hot Dipped galvanized drip-rim structural steel base extending past the pump flanges allowing all condensation to be accumulated. Galvanized integral drain pan.
 6. Falk all-metal center dropout spacer coupling
 7. Totally enclosed metal or high-impact polyethylene plastic (Orange Peel) coupling guard per ANSI B15.1, Section 8 and OSHA 1910.219
 8. Suction and discharge flange gauge ports
 9. Fully enclosed bronze impeller keyed to the shaft
 10. 304 Stainless steel shaft minimum
- B. End suction pump volute with integrally cast pedestal support foot for back pullout to allow pump to be serviced without disturbing the system piping. Pumps utilizing pedestal mounted bearing frames in lieu of volute will not be accepted.
- C. Bearings:
1. Conform to Anti-Friction Bearing Manufacturers Association (AFBMA) Standards
 2. Ball or roller bearing pillow block type
 3. Self-aligning
 4. AFBMA L50 rating of 200,000 hours

- D. Horizontal or vertical split case pumps: Double row grease lubricated ball bearing each side.
- E. Provide each pump with an internally flushed mechanical seal. If external flush line is required, provide sediment filter for each line.
 - 1. Use seal materials suitable for the pumped liquid
 - 2. Renewable bronze or stainless shaft sleeve
- F. Provide each pump with a stuffing box with packing:
 - 1. Hardened 440C stainless steel renewable shaft sleeve
 - 2. Bronze gland and stainless steel gland bolts
 - 3. Oil graphite packing
- G. Paint entire unit with two coats of machinery enamel after completion of installation.
- H. Pump Motor:
 - 1. Premium efficiency
 - 2. Totally enclosed fan cooled
 - 3. Cast iron frame and end plate
 - 4. Forge steel lifting eye
 - 5. Over sized conduit box with ground lug
 - 6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve
 - 7. Designed for Variable Frequency Drive Application
 - 8. Provide with factory installed shaft grounding rings by AEGIS.
 - 9. Minimum Efficiency

3 hp	1800 rpm	89.5%
5 hp	1800 rpm	90.2%
7.5 hp	1800 rpm	91.7%
10 hp	1800 rpm	91.7%
15 hp	1800 rpm	92.4%
20 hp	1800 rpm	93%
25 hp	1800 rpm	93.6%
30 hp	1800 rpm	94.1%
40 hp	1800 rpm	94.5%
50 hp	1800 rpm	94.5%
60 hp	1800 rpm	95%
75 hp+	1800 rpm	95.4%

- I. Data plates:
 - 1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
 - 2. Locate the nameplate for easy visibility.
 - 3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)

- e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- J. The schedule on the drawing sets forth the type of pump and GPM required.
- 1. The head capacities and horsepower are for bidding purposes only.
 - 2. Make pump selection based on actual system calculations.
- K. Acceptable manufacturers:
- 1. Armstrong
 - 2. Amtrol/Thrush
 - 3. Aurora
 - 4. Bell & Gossett
 - 5. Grundfos
 - 6. Patterson
 - 7. Weinman
 - 8. TACO

2.02 VERTICAL IN-LINE (VIL) PUMPS

- A. Pump Construction:
- 1. Pump casing, cast iron with 125 psig ANSI/PN16 flanges for working pressure below 175 psig at 150°F and ductile iron with 250 psig ANSI / PN25 flanges for working pressure to 375 psig at 150°F.
 - 2. Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
 - 3. Impeller: Bronze, fully enclosed type; dynamically balanced, two-plan balancing is required where installed impeller diameter is less than 6 times the impeller width.
 - 4. Shaft: Provide stainless steel pump shaft.
 - 5. Coupling: Rigid spacer type of high tensile aluminum alloy. Coupling is to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.
 - 6. Mechanical seals shall be stainless steel multi-spring inside or outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide 316 stainless steel glad plate. Provide factory installed flush line with manual vent.
 - 7. Split coupled pumps shall be provided with a lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.
 - 8. Provide seal flush supply line to the mechanical seal with a 50 micron cartridge filter and sight flow indicator to suit the working pressure encountered. Filters

shall be changed by the installing contractor after system is flushed and on a regular basis until turned over to the Owner.

9. Supply in the flush line to the mechanical seal a maintenance free sediment separator with sight flow indicator.

- B. Single stage, single or double suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows and heads and motor speed, enclosure, efficiency and power requirements and other system conditions.

- C. Pump Motor:

1. Premium efficiency
2. Totally enclosed fan cooled
3. Cast iron frame and end plate
4. Forge steel lifting eye
5. Over sized conduit box with ground lug
6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve
7. Designed for Variable Frequency Drive Application
8. Minimum Efficiency

3 hp	1800 rpm	89.5%
5 hp	1800 rpm	90.2%
7.5 hp	1800 rpm	91.7%
10 hp	1800 rpm	91.7%
15 hp	1800 rpm	92.4%
20 hp	1800 rpm	93%
25 hp	1800 rpm	93.6%
30 hp	1800 rpm	94.1%
40 hp	1800 rpm	94.5%
50 hp	1800 rpm	94.5%
60 hp	1800 rpm	95%
75 hp+	1800 rpm	95.4%

- D. Data plates:

1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
2. Locate the nameplate for easy visibility.
3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower

- m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- E. The schedule on the drawing sets forth the type of pump and GPM required.
 - 1. The head capacities and horsepower are for bidding purposes only.
 - 2. Make pump selection based on actual system calculations.
- F. Acceptable manufacturers:
 - 1. Armstrong Series 4300
 - 2. Aurora
 - 3. Bell & Gossett
 - 4. Grundfos
 - 5. Patterson
 - 6. TACO

2.03 VERTICAL TURBINE CONDENSER WATER PUMP

- A. Pump Construction:
 - 1. Pump bowls shall be flanged and bolted, made of cast iron. Flanges shall be of sufficient cross-section to prevent deflection.
 - 2. Impellers shall be bronze enclosed type, secured to the shaft with steel tapered collets.
 - 3. Pump bowls shall be provided with replaceable bronze wear rings.
 - 4. Pump shaft shall be of stainless steel, rolled or forged, ground and sized to provide minimum deflection.
 - 5. Belled suction of cast iron.
 - 6. Base plate with each pump.
- B. Bearings:
 - 1. Bronze sleeve bearings shall be provided in each bowl and in the suction bell.
 - 2. Bowl bearings shall be lubricated by the pumped liquid.
 - 3. Suction bell bearing shall be packed permanently with non-soluble grease and fitted with a bronze sand collar.
- C. Column Assembly:
 - 1. Discharge column pipe for 10" pumps and larger shall be steel with flanged connections.
 - 2. Discharge column pipe for 8" pumps and smaller shall be with flanged or threaded connections.
 - 3. Line shafting shall be steel, rolled or forged and ground. Shaft sections shall be connected through steel threaded couplings. Minimum shaft size is 1".
 - 4. Provide water lubricated cutless rubber bearings with bronze retainers at each column connection.
- D. Surface Discharge Head Assembly:
 - 1. Above-ground mounting of close-grained cast iron with an integral discharge flange. Flange shall be 150 lb. ANSI flat face type.
 - 2. The discharge head base shall be of sufficient size and shall conform to ANSI flange drilling as required to span an opening of dimensions that shall permit removal of the complete pump unit connected below.

3. Provide two lifting lugs with capacity to support the weight of the entire pump.
4. Provide base plate.
- E. Provide each pump with a cartridge-type mechanical seal.
 1. Cast iron stuffing box and stainless steel gland bolts.
 2. Bronze seal box bearing
- F. Pump shall be provided with a basket type suction strainer of bronze or stainless steel. The net open area of the strainer shall be at least twice the area at the suction bell lip.
- G. Pump motor:
 1. Vertical direct connected.
 2. Constant speed.
 3. Premium Efficiency TEFC suitable for use outdoors.
 4. 90% efficiency at loads of 75% through 100%.
 5. So sized with relation to the pump impeller that the brake horsepower requirement will not overload the motor at any point on the pump curve.
 6. Non-reverse ratchet
 7. Provide motor internal heater for prevention of condensation.
- H. Data plates:
 1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
 2. Locate the nameplate for easy visibility.
 3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- I. The schedule on the drawing sets forth the type of pump and GPM required.
 1. The head capacities and horsepower are for bidding purposes only.
 2. Make pump selection based on actual system calculations.
- J. Acceptable Manufacturers:
 1. Pacific & Johnston
 2. Ingersoll-Rand
 3. ITT Bell & Gossett
 4. Aurora

- 5. Flo-way
- 6. Patterson

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 - 1. Provide access space around pumps for service.
 - 2. Install pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Install stainless steel drain pan with trough under chilled water pumps only.
 - 3. Provide air cock and drain connection piped to floor drain.
 - 4. Lubricate pumps prior to start-up.
 - 5. Install condenser water pumps to ensure a full flooded suction.
 - 6. Paint entire unit with two coats of machinery enamel after completion of installation.
 - 7. Provide a spool piece between the suction diffuser and the suction side of the pump minimum length 8" face to face.
 - 8. Provide pressure taps with valves on each side of the pump.
 - 9. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge. Provide an automatic air vent off the pump casing. For base mounted pumps, provide a drain line the full size of the base connection and extend it to and terminate it over the nearest floor drain.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.
- D. Ensure pumps:
 - 1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 - 2. Are non-overloading in parallel and individual operation.
 - 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.02 ALIGNMENT FOR BASE MOUNTED PUMPS

- A. Set the pump on a concrete inertia base or concrete housekeeping pad as specified; anchor, level and grout.
- B. Align the pump and driver in accordance with Hydraulic Institute Standards for centrifugal, rotary and reciprocating pumps.

- C. Realign the pump and driver after initial leveling of pump base before placing the grout and again after the grout has set and the foundation bolts are tightened. Recheck the alignment after the piping has been connected.

3.03 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
 - 1. Technicians, as required, shall be trained and experienced in the work they perform (contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
 - 1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 - 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 - 3. Submit readings for approval.
 - 4. Include the approved readings in the Owner's Maintenance Manual.

3.04 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
 - 1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 - 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 - 1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.05 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 - 1. A mechanical seal for each pump
 - 2. A set of bearings for each pump

END OF SECTION 23 21 23

SECTION 23 23 00
REFRIGERANT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping.

1.02 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Pipe and Pipe Fittings
 - 2. Piping Insulation

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. Furnish refrigerant piping of Type K hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

2.02 SERVICE VALVES

- A. Provide angle or globe service valves, with sweat connections. Use packed-type, wrench operated, valves with gasketed seal cap and back seat feature. Furnish valves designed for refrigerant service, in conformance with the ARI code.
- B. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.03 SOLENOID VALVES

- A. Furnish pilot-operated, floating-piston solenoid valves suitable for operation with refrigerant.
- B. Use valves with a bronze body and sweat-type connections.
- C. Provide stainless steel stem and plunger assembly and a stainless steel piston.
- D. Furnish sealed and moisture proof solenoid coils.
- E. Use electrical characteristics of 115 volt, 60 Hertz.

2.04 SIGHT GLASSES

- A. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

2.05 FILTER DRYER

- A. Furnish replaceable core liquid line filter dryer.
- B. Provide filter dryer constructed to permit the removal of the core element without removing the filter dryer from the line.

PART 3 - EXECUTION

3.01 BRAZING

- A. During the brazing process, dry nitrogen shall be purged through the tubing to prevent oxides from forming.

3.02 PRESSURE TEST

- A. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 450 psig.
 - 1. Test joints with a Halide torch or an electronic leak detector.
 - 2. Repair leaks and retest each system until proved tight.

3.03 EVACUATION AND DRYING

- A. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
 - 1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 48 hours).
 - 2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.

3.04 PIPE SIZE

- A. Pipe shall be routed and sized per condensing unit manufacturer's instructions.

END OF SECTION 23 23 00

SECTION 23 25 13
CIRCULATING WATER SYSTEM CHEMICAL TREATMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide equipment, chemicals and treatment materials for the complete water treatment system.
- B. Determine which chemicals to use from the results of a water sample analysis taken from the building domestic water supply.
- C. Provide water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to achieve the required water quality for each system specified.
 - 1. Closed chilled and hot water systems
 - 2. The cooling tower condenser water system
 - 3. Closed condenser water system

1.02 SERVICE AND SUPPLIES

- A. All work shall be performed by a qualified, full-time, Water Program Manager.
 - 1. Specialist in the field of industrial water treatment.
 - 2. Facilities include water analysis laboratory, development facilities and service department.
- B. Provide a water treatment test set for each system (pH, alkalinity, hardness, chloride) for field use including test equipment and reagents as required for specific use with the treatment products employed.
- C. Where specialized supplementary testing or control equipment is required, provide appropriate items.
- D. Provide a water management and service program for a period of one year beginning at substantial completion. Make routine visits bi-weekly during first two months of operation and monthly during the remainder of the specified period.
- E. Routing Services
 - 1. Check and adjust water treatment system operation.
 - 2. Instruct, train and advise operating personnel.
 - 3. Check efficiency of chemicals and chemical applications.
 - 4. Replenish chemicals and replace expendables.
 - 5. Clean or replace filter in feeder.
- F. Chemically clean the piping system.
- G. Provide a complete laboratory analysis of water samples. Insert in the Owner's manuals.
- H. Provide review of report figures in the field water testing.

1.03 QUALITY ASSURANCE

- A. Acceptable program manager shall have:
 - 1. Research and development facilities.
 - 2. Regional laboratories capable of making water analysis.
 - 3. A service department and qualified technical service representatives located within a reasonable distance of the project site.
 - 4. Service representatives who are registered Engineers or factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.
- B. Ensure that all products, packaging, blow-down or other effluents do not violate local, state, or federal laws or regulations. Use only chemicals that are registered, when required, with the U.S. Department of Agriculture or the U.S. Environmental Protection Agency and that are labeled as required by law.
- C. Provide electrical products that have been tested, listed and labeled by Underwriters Laboratories and comply with the National Electrical Manufacturers Association Standards.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Worth Hydrochem of Houston
- B. Nalco Chemical Company
- C. Allegheny Southwest
- D. Garret-Callahan
- E. Lakewood Instruments Uniloc Division
- F. Hydro Systems, Inc.

2.02 CLOSED CHILLED AND HOT WATER SYSTEM / CLOSED CONDENSER WATER SYSTEM

- A. By-pass filter feeders in the hot water and chilled water systems:
 - 1. Rated at 40-gpm capacity.
 - 2. Operating conditions: 150 psig and 250°F.
 - 3. Quick opening cap with a Buna N-O ring seal; or 1-1/2" valve and funnel.
 - 4. 5 micron polypropylene filter bag mounted in a perforated stainless steel holder. Filter bag shall be supported from top of feeder.
 - a. Filter bag and holder shall extend full length of feeder tank.
 - b. Bottom feed tanks are not acceptable.
 - 5. Fabricated hot dipped galvanized steel support legs and frame. Refer to detail drawing for requirements.
 - 6. Provide sufficient quantity of filter bags for warranty period. Minimum of six additional bags provided to owner.

- B. Acceptable Manufacturers
 - 1. Neptune Model FTS-5
 - 2. Efficiency Dynamics FF-100.
 - 3. J.L. Wingert Model FHC-5HD.
 - 4. Hydro-systems HS-800
 - 5. Vector Industries, Inc. FA-900
- C. Treatment chemicals:
 - 1. Furnished as a concentrated liquid in 5 gallon pails
 - 2. A corrosion inhibitor of the nitrite-borate type.
 - 3. Maintained at a nitrite residual of 600 – 800 ppm in chilled loops and 1000-1500 in hot loops.
 - 4. With effective copper, black iron, stainless steel and aluminum corrosion inhibitors.
 - 5. Form a protective film to prevent corrosion and scale formation.
 - 6. Have colored dye to indicate presence.
- D. Multiple chemicals used in a common system shall be compatible.
- E. Flow Indicator:
 - 1. Bronze Construction
 - 2. Rotating Wheel
 - 3. Line Size
 - 4. Double Window
 - 5. Ernst Flow Industries Model EFIE-57-3

2.03 CONDENSER WATER SYSTEM

- A. Prefabricated Panel Mounted System consisting of the following for each chiller / cooling tower:
 - 1. 1 each Conductivity controller.
 - 2. 3 each Chemical feed pumps.
 - 3. Sample stream piping assembly on high-density polyethylene panel.
 - 4. Prefabricated panel with stainless steel hardware utilized in securing system components.
 - 5. System sample stream piping assembly shall be constructed of schedule 80 CPVC, and shall consist of inlet and outlet ball valves, clear Y strainer, sample valve, conductivity electrode, three chemical injection stations and flow switch.
- B. Conductivity Controller:
 - 1. The Controller shall be a microprocessor based, menu driven industrial type conductivity controller.
 - 2. With relay activated on/off control outputs.
 - 3. 0-1000 microsiemen control range with displayable a 16 character, backlit LCD display.
 - 4. Adjustable High/Low alarm points Option: with output relays and 4-20ma output.
 - 5. The controller shall provide four programmable, non-concurrent operational modes for inhibitor feed using either:
 - a. Feed as % of bleed.

- b. Feed and bleed with limit timer.
 - c. Percent of time.
 - d. Water meter triggered feed.
- 6. The Controller shall provide 2 two independent programmable biocide feed functions programmable in cycle modes of 1 to 4 weeks.
- 7. An adjustable pre-bleed function based on time or conductivity and programmable lockout feature shall be provided for each individual biocide feed.
- 8. Controller shall be an LMI model DC-4500111A1 or approved equivalent.
- C. Chemical Metering Pumps:
 - 1. Chemical metering pumps shall be positive displacement, Liquifram type pumps.
 - 2. Output volume shall be adjustable while pumps are in operation from 0 to maximum capacity of 14 Gallons per day.
 - 3. Adjustment shall be by readily accessible dial knobs, one for changing stroke length and the other for changing stroke frequency.
 - 4. On-off switch shall be integral with frequency control.
 - 5. Chemical pumps shall be capable, without a hydraulically backed diaphragm, of injecting chemicals against pressures.
 - 6. Valves shall be cartridge type and renewable by replacing only the cartridge.
 - 7. Pump head and fittings shall be of PVDF or CPVC construction.
 - 8. Chemical pumps shall be LMI Model A141-352SI or approved equivalent.
- D. Water Meter for Cooling Tower Make-Up:
 - 1. Electric Contacting Head Water meter which shall be a multi jet design with bronze body and sealed register sized for required make-up flow.
- E. Solenoid Valve/Blow-Down Assembly:
 - 1. Solenoid shall be of brass body construction design and require 0 psi of backpressure to close.
 - 2. Pre-fabricated Blow-down with isolation valve and “y”-strainer sized for required blow-down.

PART 3 - EXECUTION

3.01 INSTALLATION/START-UP

- A. In accordance with manufacturer's recommendations.
- B. Anchor the chemical filter feeder to a concrete housekeeping pad using wedge type expansion anchors.
- C. Clean and flush closed loops systems.
 - 1. Clear water flush systems before introducing chemical cleaners.
 - 2. Chemical cleaner shall be introduced into the systems to remove construction related oils, greases, threading compounds, and silt.
 - 3. Chemical Cleaner shall passivate and pre-film pipe system.

3.02 WATER ANALYSIS

- A. The chemical treatment agency shall provide the services of a testing laboratory to

perform a site water analysis. As a minimum, conduct the following tests in accordance with ASTM standards and to the satisfaction of the Owner/Architect/Engineer.

1. Silica in water and wastewater.
 2. Acidity or alkalinity of water.
 3. Iron in water.
 4. Hardness of water.
 5. Ph of water.
 6. Particulate and Dissolved Matter, Solids or Residue in Water.
 7. Turbidity in water.
 8. Corrosivity of water in absence of heat transfer.
 9. Standard practices for sampling water.
- B. Take water samples in accordance with ASTM.
- C. Prepare a test report in accordance with ASTM for each of the tests conducted.
- D. Submit the test reports to the Architect/Engineer.

3.03 CHEMICAL TREATMENT

- A. The chemical treatment agency shall provide complete services necessary for chemically cleaning and treatment the following systems:
1. Chilled water.
 2. Hot water.
 3. Condenser water.
- B. The chemical treatment agency shall provide, but not be limited to the following:
1. Equipment and installation.
 2. Chemicals.
 3. Analytical and testing work.
 4. Inspection.
 5. Calculations.
 6. Assistance to the trade installing the piping.
 7. Instruction to Owner.
- C. Determine which chemicals to use from the results of site water analysis. Provide the chemical necessary to achieve the desired water condition.
- D. Examine and supervise flushing and pipe cleaning operations and verify that the systems are clean, free of debris and rust and other construction materials before starting water treatment.
- E. After the piping has been flushed, cleaned, rinsed and charged with chemicals, then start-up and operate the chemical treatment equipment to provide steady, stable characteristics for the systems treated.
- F. During construction, instruct the Contractor in the field piping and wiring of chemical feeding equipment. If such piping and wiring details are not shown on the Contract Drawings, then provide all equipment, piping, wiring, instrumentation and chemicals to provide a complete and operating system without additional cost.

- G. After the chemical treatment is functioning as intended, the chemical treatment agency shall demonstrate to the Architect/Engineer the chemical treatment operation.

3.04 OWNER TRAINING

- A. A chemical treatment agency, in conjunction with the chemical treatment equipment manufacturer's factory representative, shall train the Owner to operate and maintain the chemical treatment system as a whole and in part for each piece of equipment.
- B. Furnish to the Owner a chemical treatment administration manual covering the chemical treatment program for each of the systems treated. The manual shall include, but not be limited to:
 - 1. Name, address and telephone number of the chemical treatment agency and each of the equipment manufacturers.
 - 2. Operation and maintenance manuals.
 - 3. Test reports.
 - 4. Chemical data sheets.
 - 5. A narrative describing the chemical treatment program for each of the systems being treated.

3.05 TESTING AND INSPECTION

- A. After the systems have been accepted, the chemical treatment agency shall visit the site every month during the warranty period.
- B. During each visit:
 - 1. Check and adjust the chemical treatment equipment.
 - 2. Check the chemistry of the treated system to confirm the chemicals are maintaining the system as intended.
 - 3. Advise and instruct the Owner on operational changes made to the chemical treatment program.
 - 4. Take a water sample of each system being chemically treated and have the samples tested by a testing laboratory. Prepare a report for each water sample and submit it to the Owner. Include in the test report the changes that need to be made to the chemical treatment program.
 - 5. Maintain complete records of the treatment program for each system at the project site. Keep the records in a hardbound manual with the building manager. A second copy shall be maintained by the agency for the agency's records.
- C. Routine visits must be coordinated with the Owner.
- D. Send copy of monthly report to Engineer for Verification.

END OF SECTION 23 25 13

SECTION 23 31 13
DUCTWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions.

1.02 RELATED WORK

- A. Division 23 Mechanical
 - 1. Air Devices
 - 2. Air Handling Units
 - 3. Insulation
 - 4. Terminal Units
 - 5. Fan Coil Units
 - 6. Fans
 - 7. Packaged Rooftop Air Conditioners
 - 8. Testing, Balancing and Adjusting (TAB) of Environmental Systems
- B. Division 9 – Finishes, Painting and Color Coding

1.03 QUALITY ASSURANCE

- A. The intent of ductwork specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide ductwork in accordance with the specifications for each type of service.
- B. An approved contractor for this work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 5 systems of comparable size and type that have served their owners satisfactorily for not less than 5 years.

1.04 GUARANTEE

- A. Guarantee ductwork for 1 year from the date of substantial completion. The guarantee covers workmanship, noise, chatter, whistling, or vibration. Ductwork shall be free from pulsation under conditions of operation.

1.05 CONTRACTOR COORDINATION

- A. Erect ducts in the general locations shown, but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.
- B. Coordinate location of ductwork with structural members and Architectural drawings and

requirements.

1.06 SHOP DRAWINGS AND SAMPLES

- A. Submit shop drawings of all ductwork layouts, including enlarged plans and elevations of all air handling equipment, and submit details of duct fittings, including particulars such as gauge sizes, welds, and configurations prior to starting work.
- B. Submit product data and sealing materials to be used.
- C. Submit sound attenuation data.
- D. Submit shop drawings in plan, elevation and sections, and three-dimensional view showing equipment in mechanical equipment areas.

PART 2 - PRODUCTS

2.01 STANDARDS AND CODES

- A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

2.02 DUCT MATERIAL AND CONSTRUCTION

- A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.
- B. Rectangular low and medium pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.
- C. Medium pressure oval and round ductwork shall be spiral seam. Spiral lock-seam SMACNA Type RL-1. Fittings shall be welded construction.
 - 1. Galvanized
 - 2. Stainless Steel
 - 3. Aluminum
 - 4. Paint Grip
 - 5. Perforated
- D. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.
- E. Dishwasher Hood Exhaust System: Welded 304 Stainless steel.
- F. Shower Area Exhaust Systems: Welded 304 Stainless steel.
- G. Kitchen exhaust duct: Welded Black steel, minimum 16 gauge

H. Natatorium Ductwork: 304 Stainless Steel

2.03 ACOUSTICAL DUCT

- A. Duct and fittings:
1. Double wall acoustically treated.
 2. Annular space packed with fiberglass insulation.
 3. Perforated metal liner to provide specific acoustic impedance
 4. Insulation 1.0 pcf. 1 inch thick
 5. United McGill Acousti-K27 spiral lockseam or approved equal
 6. Material as indicated below:
 - a. Paintable Galvanized Steel
 - b. Stainless Steel
 - c. Aluminum
- B. Pressure rating and tests as specified for single wall ductwork.

2.04 DUCT SEALING OF SEAMS AND JOINTS

- A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine made spiral lock seams, joints and seams made air tight with duct sealer.
1. Indoor applications – Foster 32-14
 2. Outdoor applications – Foster 32-17

2.05 FLEXIBLE DUCT LOW PRESSURE

- A. Construction:
1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
 - a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
 2. UL 181 Class I air duct label
 3. Reinforced vapor barrier jacket
 4. Rated for use at system pressure (6" wc minimum)
 5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.
- B. Fire hazard classification:
1. Flame spread rating 25 maximum.
 2. Smoke developed rating 50 maximum.
- C. Thermal characteristics:
1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 3. 2" minimum wall thickness insulation with 1" overlap
- D. Acceptable manufacturers:

1. Flexmaster
2. Hart & Cooley
3. Omniair
4. Peppertree Air Solutions

2.06 FLEXIBLE DUCT MEDIUM/HIGH PRESSURE

- A. The duct shall be constructed of a heavy coated fiberglass cloth fabric supported by helical wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
- B. The internal working pressure rating shall be at least as follows with a bursting pressure of at least two times the working pressure:
Positive: 12" w.g.
Negative: 5" w.g.
- C. The duct shall be rated for a velocity of at least 5500 fpm.
- D. Suitable for operating temperature range of -20°F to +250°F.
- E. Factory insulate the flexible duct with fiberglass insulation.
 1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 3. 2" minimum wall thickness insulation with 1" overlap
- F. Cover the insulation with a fire retarding polyethylene vapor barrier jacket having a permeance of not greater than 0.10 perms when tested in accordance with ASTM E96, Procedure A.
- G. Acceptable manufacturers:
 1. Flexmaster
 2. Omniair
 3. Peppertree Air Solutions

2.07 DUCT BOARD

- A. Construction:
 1. Rigid, resin bonded fibrous glass board with damage-resistant, flame retardant, reinforced aluminum foil (FRK) facing.
 - a. Pressure Sensitive Tape listed and labeled under UL 181A, Part I(P). All longitudinal and circumferential joints stapled with outward flaring 2-1/2" staples, 2" on center. Coat all joins and seams with duct closure mastic. Foster 95-90 / 95-96. Mastic shall meet UL 181A-M and UL 181B-M.
 2. UL 181 Class I air duct label
 3. Provide mat air stream surface to isolate glass fiber substrate from air stream and inhibit penetration by dirt, dust and other pollutants. Air stream surface shall include an EPA registered biocide to protect air stream surface from microbial growth and meet requirements of ASTM C 138, ASTM G 21 and ASTM G 22.
 4. Operating static pressure to +/- 2 inches water gauge, internal air temperatures 40 degrees F to 250 degrees F and air velocities up to 6,000 feet per minute.

- B. Fire Hazard classification:
 - 1. Flame spread rating 5 maximum
 - 2. Smoke developed rating 50 maximum
- C. Thermal characteristics:
 - 1. R-6 BTU/hr/sp. Ft./°F
 - 2. 1-1/2" thick
- D. Acceptable Manufacturers:
 - 1. Owens Corning

2.08 FIRE DAMPERS

- A. Fire dampers for required wall ratings that are 95% minimum free area. Provide Type B or Type C UL dampers for low, medium and high-pressure rectangular, square or round ducts. Dampers shall be activated by a fusible link designed to react at 165°F. Install per manufactures recommendations to provide a UL assembly. Provide sealed sleeve to meet desired leakage performance.
- B. Acceptable Manufacturers:
 - 1. Ruskin
 - 2. Prefco Products
 - 3. Air Balance
 - 4. Greenheck, Inc.
 - 5. Nailor Industries
 - 6. Pottoroff

2.09 CEILING RADIATION DAMPERS

- A. Ceiling Radiation Dampers at location shown on plans constructed and tested in accordance with the current edition of UL555C of a minimum 22 gauge (0.8) blades, hinged in the center and held open with a 165° fusible link. Maximum blade height in the open position shall be 10" overall regardless of damper area. Maximum distance between blades held in the open position shall be 1-1/4" for units not requiring blade insulation and 1/4" for units with sheetrock blade insulation. Blades requiring radiation protection insulation shall utilize sheetrock. Refractory Ceramic or Mineral Wool Fiber is not allowed in the air stream. Radiation insulation outside of the air stream shall be Mineral Wool Fiber only. Ceramic Fiber Material is not approved for use. Units shall be constructed of a minimum 20-gauge (0.9) frame welded at all seams.
- B. Acceptable Manufactures
 - 1. Ruskin
 - 2. Prefco
 - 3. Air Balance
 - 4. Phillips
 - 5. Safe-Air
 - 6. Nailor Industries

2.10 WALL LOUVERS

- A. Refer to schedule on drawings. Coordinate with Architectural Drawings.
- B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.
- C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.
- D. Acceptable manufacturers:
 - 1. American Warming and Ventilation
 - 2. Arrow
 - 3. Greenheck
 - 4. NCA
 - 5. Pottorff
 - 6. Ruskin

2.11 FLUES FOR ATMOSPHERIC BOILERS AND WATER HEATERS

- A. Type B, round or oval, double-wall vent pipe, equal to Metalbestos or Metal-Fab, including accessories such as vent caps by the same manufacturers. Use oval vent where necessary to fit in wall construction. All exterior components shall be 304 stainless steel for outdoor installations.

2.12 FLUES FOR POWER EXHAUST AND HIGH EFFICIENCY BOILERS AND WATER HEATERS

- A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 550°F maximum flue gas temperature and with a UL tested pressure rating of 40 inches w.c. The interior pipe shall be constructed of AL 29-4C stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-1738 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.13 FLUES FOR FAN POWERED FIRETUBE BOILERS AND WATER HEATERS

- A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 1400°F continuous operation, 1800°F intermittent operation and for positive pressures up to 60 inches w.c. The interior pipe shall be constructed of 304 stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one-inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-103 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.14 FLUE CAPS

- A. Stainless steel flue caps of a design so that wind action from any direction will create a vacuum in the flue. Caps as manufactured by Breidert or equal are acceptable. Refer to installation details on drawings.

2.15 DUCT LINING

- A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

2.16 CONTROL DAMPERS

- A. Opposed blade dampers for 2-position and modulating control. Construct frames of 13-gauge galvanized sheet metal with provisions for duct mounting. Damper blades not exceeding 8" in width, of corrugated-type construction, fabricated from two sheets of 22-gauge galvanized sheet metal spot-welded together or a single 16-gauge sheet. Make bearings of nylon or oil-impregnated, sintered bronze. Make shafts of 1/2" zinc-plated steel. Blades suitable for high velocity performance. Construct damper so that leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure. Provide replaceable resilient seals along top, bottom and sides of frame and along blade edge. Submit leakage and flow characteristics data with shop drawings. Linkage shall be concealed out of the air stream within damper frame to reduce pressure drop and noise.
- B. Acceptable Model is Ruskin Model CD60.

2.17 VOLUME DAMPERS

- A. Manual balancing dampers that meet or exceed the following minimum construction standards:
 - 1. Frame 16-gauge
 - 2. Blades 16-gauge
 - 3. Bearings corrosion resistant
 - 4. Concealed linkage
 - 5. Opposed blade dampers
- B. Acceptable manufacturer:
 - 1. Ruskin Model MD-35 or approved equal, by
 - 2. Arrow
 - 3. American Warming and Ventilating
 - 4. Nailor Industries
 - 5. Pottoroff

2.18 ACCESS DOORS

- A. Round spin-in door of galvanized steel.
 - 1. Fire proof sealing gaskets and quick fastening locking devices
 - 2. Insulated door
 - 3. Conform to the requirements of the NFPA
 - 4. Identification and use of each access door
 - 5. UL label to match the construction in which it is installed
 - 6. Cable attached to door and outer frame
 - 7. Low leakage Access Door
- B. Acceptable Manufacturer

1. Flex master, Inspector Series
2. Approved Equal

2.19 COMBINATION FIRE/SMOKE DAMPERS

- A. Combination fire/smoke dampers meeting the following requirements:
1. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16-gauge galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
 3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
 4. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. After exposure to high temperature of fire, the damper must be inspected prior to reset to ensure proper operation. Release temperature is 165°F.
 5. Provide UL555S qualified electric actuator at 120 VAC.
 6. Provide air-foil type blades.
- B. Provide integral sleeves
- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottoroff

2.20 SMOKE DAMPERS

- A. Smoke dampers meeting the following requirements.

1. Each smoke damper shall be classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16 gauge, galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
 3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
 4. Provide UL555S qualified electric actuator at 120 VAC.
 5. Provide air-foil type blades.
- B. Provide integral sleeves.
- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottoroff

2.21 DIFFUSER FITTINGS LOW PRESSURE TAPS

- A. Fitting shall meet or exceed the following minimum construction standards:
1. Conical with a base diameter two inches larger than the tap diameter.
 2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
 - a. Fitting with a 3/16-inch high stop bead approximately 2-1/2-inches from the discharge end of the fitting
 - b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy duty locking quadrant.
 - c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
 3. Match the fitting body gauge to the SMACNA duct gauge, but not less than:
 - a. Through 8 inches: 26 gauge; Damper blade 22 gauge
 - b. 10 inches and 12 inches: 24 gauge; Damper blade 22 gauge
 - c. 14 inches and 16 inches: 22 gauge; Damper blade 22 gauge
 - d. 18 inches and 20 inches: 20 gauge; Damper blade 20 gauge
 4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.

5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.
6. Provide the damper with a self-locking regulator and handle.
7. Provide a 2" sheet metal stand-off to extend the regulator.
8. Flex duct grip area – 2 inches behind retaining bead
9. Flex duct retaining bead – 1 inch from end
10. Conical length of at least 3 inches
11. Barrel length of at least 9 inches

2.22 AUXILIARY DRAIN PANS

- A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2", all joints soldered watertight. Pan is to be large enough to complete cover drip lines of unit.

2.23 DUCTWORK SUPPORTS ON ROOF

- A. Support ductwork on roof with Portable Pipe Hanger Model PHP-D fully adjustable height and width. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized framing. Nuts and washers shall be hot dip galvanized.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.
- B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.
- C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.
- D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.
- E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.
- F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.
- G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.
- H. Fire Dampers shall be installed per manufacturer's recommendations to create a UL rated

assembly.

- I. Install end bearing at all location where damper shaft penetrates duct wall.
- J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

3.02 DUCTWORK

- A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction. All ductwork between the variable volume air handling units and the terminal units shall be constructed to the medium pressure ductwork specification.
- B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.
- C. For branch ducts wider than 18", and when shown on drawings provide extractors with an appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.
- D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
 - 1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
 - 2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.
- E. Use pushrod operator with locking nut and butt hinges assembly.
- F. Provide opposed-blade volume dampers with an appropriate control device in each of the following locations:
 - 1. Return air ductwork
 - 2. Outside air branch duct
 - 3. Exhaust branch duct
 - 4. Exhaust connections to hoods except kitchen grease hoods or equipment
 - 5. In each zone at multi-zone unit discharge installed downstream of duct mounted re-heat coils
 - 6. At each outside air and return air duct connection to plenum of constant volume units
 - 7. At discharge side of constant volume boxes
 - 8. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
 - 9. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.

- G. Elbows:
1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single-wall or airfoil turning vanes. Job-fabricated turning vanes, if used, shall be single-thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.
 2. Round Oval Duct. Provide elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5 piece, 90° elbows and 3 piece, 45° elbows.
- H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.
- I. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.
- J. Insulated Flexible Duct:
1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet metal collars and stainless steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal insulation material.
 2. Construct bends over 45° with sheet metal elbows.
- K. Duct Supports:
1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
 2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on at least 8' centers in accordance with SMACNA Standards.
 3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
 4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4 or 5 times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.
- L. Branch connections for medium pressure ductwork shall be made with a conical lateral.

Field installed conical branch ducts shall be minimum 20-gauge galvanized sheet metal, "Everdur" welded and coated with "Galvabar".

3.03 PLENUMS

- A. Return air plenums shall be rectangular galvanized sheet metal ductwork.
- B. Fabricate plenums upstream of fan of 16-gauge material.
- C. Fabricate plenums upstream of filters minimum 18-gauge material.

3.04 FLEXIBLE CONNECTIONS

- A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where connections are made in outdoor locations, seal fabric to metal with mastic.

3.05 ACCESS DOORS

- A. Install ductwork access doors as noted below, arranged for convenient access. Stencil each door for specific use. Install access doors in each of the following locations: *Some clients want doors on both sides of dampers.
 - 1. Fire Dampers
 - 2. Smoke Dampers
 - 3. Smoke/fire Dampers
 - 4. Outside Air Dampers
 - 5. Duct Mounted Coils (up-stream)
 - 6. Control Dampers
 - 7. 12"x12" access door for cleaning at a maximum distance of 20'-0" from center of adjacent access door. CY-FAIR REQUIREMENT
- B. Size access door 1" smaller than ductwork.
 - 1. Available Sizes: 8", 10", 12", 18", 24"
- C. Construct access door air tight, and conform to recommendations of NFPA and SMACNA.
- D. Demonstrate suitability of access for the intended purpose. Install multiple access doors as required.

3.06 DUCT LINING

- A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.

- B. Provide metal nosing that is either channeled or "Z" profiled or are integrally-formed from the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.
- C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.
- D. Do not install liner in multi-zone unit ductwork.

3.07 SEALING OF SEAMS AND JOINTS

- A. Seal supply, return, exhaust and outside air duct systems.

3.08 FLUES

- A. Provide and install flues for all gas fired equipment.
- B. Refer to plans for all related locations.
- C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment manufacturers.
- D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.
- E. Terminate flues at height above roof to prevent flue gas from entering the building.

3.09 DISHWASHER HOOD EXHAUST SYSTEM

- A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot to drain toward the washer.

3.10 SHOWER AREA EXHAUST SYSTEM

- A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot slope down to grille connection. Install in accordance with Fig. 2-21 of SMACNA HVAC Duct Construction Standards.

3.11 KITCHEN EXHAUST DUCT

- A. All material and fittings shall be minimum 16 gauge, coated black steel to prevent rusting. All seams and joints in the kitchen exhaust duct, and penetrations of the hood enclosure to its lower outermost perimeter that directs and captures grease-laden vapors and exhaust gases shall have a liquid tight continuous external weld. All ducts shall be installed without forming dips or traps that might collect residues. Provide 18" x 18" or equal area at each elbow and as required for cleaning access, in direction of air flow. UL Listed access panel shall be located on the vertical wall of the duct 1-1/2" from the bottom of duct and shall be fitted with two handles, grease and air tight fitting access door and latch. All interior surfaces of ducts shall be accessible for cleaning and

inspection purposes. Duct shall maintain minimum 1/4" per lineal foot slope to the exhaust hood. Provide duct over lay at the roof curb for a complete seal. Install kitchen exhaust system per local authority. In the absence of a local authority, the requirements of the Uniform Mechanical Code and NFPA 96 shall govern.

3.12 FUME HOOD EXHAUST SYSTEM

- A. All material and fittings shall be 304 stainless steel construction.

3.13 ACOUSTICAL DUCT

- A. Install in the following locations:
 - 1. Gymnasiums
 - 2. Auditorium
 - 3. And/or where indicated on the drawings

3.14 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by the Contractor that lead to, or are, outdoors; screens shall be No. 16 gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

3.15 CONNECTIONS TO LOUVERS

- A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.
- B. Where plenums are installed on inside of louver, construct such that bottom of plenum will lap over bottom blade of louver to drain any water that may enter.

3.16 PLENUMS

- A. Construct plenums with galvanized steel framing members and galvanized sheet steel, cross braced and rigidly braced with galvanized angles. Gauges and bracing shall conform to SMACNA recommendations for ductwork of like sizes. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.
- B. Provide access doors.

3.17 AUXILIARY DRAIN PANS

- A. Where coils that have a condensate drain are located above ceiling.

3.18 TESTING OF LOW PRESSURE DUCTWORK

- A. Test ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow.

- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers and pressure vs CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains at 1-1/2 times design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.
- D. Ductwork down stream of terminal boxes, return, exhaust, and outside air ducts are to be visually inspected.

3.19 TESTING OF MEDIUM AND HIGH PRESSURE DUCT

- A. As the project progresses, test the ductwork in sections.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers, and pressure vs. CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Finally as a complete system, test ductwork at a minimum of 2.5" with a maximum allowable leakage of 1% of the total design supply airflow.
- D. Test method as set forth in SMACNA "HVAC Duct Construction Standards".

END OF SECTION 23 31 13

SECTION 23 34 16
FANS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install fans, including centrifugal, axial and propeller types, with supplemental equipment.

1.02 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Ductwork
 - 2. Vibration Isolation
 - 3. Air Balance
 - 4. Electrical Provisions of Mechanical Work

1.03 PERFORMANCE

- A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.
- B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA Standards. All fans provided must be licensed to bear the Certified Ratings Seal.
- C. Statically and dynamically balance all fans.
- D. Motors shall be sized so that they do not operate within the motor service factor.
- E. Fans shall be capable of 120% of the scheduled air capacities.
- F. All static pressures shown on schedules are external to fans. Manufacturer shall add damper and accessory losses to scheduled value before selecting fan.

1.04 SUBMITTALS

- A. Submit fan performance curves with system operating point plotted on curves.
- B. Submit manufacturer's printed installation instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cook

- B. Greenheck
- C. Penn Barry Ventilator
- D. Twin City Fans

2.02 PROTECTIVE COATINGS

- A. Manufacturer's Standard. Apply to fans, motors and accessories, the manufacturer's standard prime coat and finish, except on aluminum surfaces or where special coatings are required.
- B. Galvanizing. After fabrication of the parts, hot-dip coat surfaces that require galvanizing. Where galvanizing is specified, a zinc coating may be used. After fabrication, apply the zinc coating and air-dry the coating to 95% pure zinc. Acceptable zinc coatings include Zincilate, Sealube, Amercoat, Diametcoat, or an approved equal.

2.03 SUPPLEMENTAL EQUIPMENT

- A. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.
- B. Belt Drives:
 - 1. Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20% speed variation from full open to full closed. Size drives for 150% of rated horsepower. Key the fan sheave to the fan shaft.
 - 2. Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.
 - 3. Provide belt guards and apply the same finish as used on the fan.
 - 4. Oil and heat resistant, nonstatic type belts.
 - 5. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty, regreasable, ball type, in a pillow block, cast iron housing, selected for a minimum L50 life in excess of 200,000 hours at maximum catalog operating speed.
- C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.
- D. Relief Vents and Air Inlets: Provide vents and inlets with aluminum frames and 1/2" mesh, galvanized bird screens. Include dampers where shown.
- E. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.

- F. Dampers. Where automatic backdraft damper is scheduled:
 - 1. Multi-bladed.
 - 2. Heavy duty.
 - 3. Roll formed aluminum blades.
 - 4. Nylon bearings.
 - 5. Neoprene weather strip on blade edge.
- G. Where motorized damper is scheduled:
 - 1. The motor and damper are specified in the Building Management and Control System Specification.
- H. All fans are to be provided with a durable, deep etched, .025" thick, factory installed aluminum identification plate with the following information. Plates are to be furnished with four mounting holes.
 - 1. Fan mark as indicated on the Contract Drawings.
 - 2. Serial number
 - 3. Model number
 - 4. Capacity (CFM) and static pressure.
 - 5. Motor HP
 - 6. Motor Amps
 - 7. Manufacturer
 - 8. Motor phase
 - 9. Number of Belts/Make/Size
 - 10. Motor volts

2.04 VENTILATION AND EXHAUST FANS

- A. Provide the ventilation and exhaust fans shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Provide each belt driven fan with approved, totally enclosed belt guard.
- D. Provide approved safety screen where inlet or outlet is exposed.
- E. Provide duct flanges where required for connections.
- F. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.
- G. Furnish supply fans with 1" aluminum, washable filter section.

2.05 ROOFTOP VENTILATION AND EXHAUST SYSTEMS

- A. Provide the rooftop ventilation and exhaust systems shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Components:
 - 1. Aluminum, stainless steel or plastic coated bird guard.
 - 2. Screws and fasteners of stainless steel or nonferrous material.

- 3. All aluminum construction unless indicated otherwise on fan schedule.
- D. Welded construction, corrosion resistant fasteners, minimum 16 gauge marine alloy aluminum.
- E. Aluminum base shall be continuously welded curb cap corners.

2.06 GRAVITY ROOF-TOP INTAKE AND RELIEF VENTS

- A. Provide the rooftop intake and relief vent systems shown on the drawings.
- B. Provide with aluminum, stainless steel or plastic coated bird guard.
 - 1. Screws and fasteners of stainless steel or nonferrous material
 - 2. All aluminum construction
- C. Welded construction, corrosion resistant fasteners, minimum 16-gauge marine alloy aluminum.
- D. Aluminum base shall be continuously welded curb cap corners.

2.07 OSCILLATING AIR CIRCULATOR FAN

- A. Three speed CFM Low 1657 – CFM Medium 2060 – CFM High 3100
- B. Totally enclosed motor voltage – 120 Voltage – 60 Hz
- C. Cast Aluminum 20-inch diameter, three blade fan with OSHA Guard
- D. Wall Mounted
- E. Factory wired 10', 3 conductor with ground molded plug
- F. Acceptable Manufacturer: Dayton 4PRV7 or approved equal

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings. Ensure fan location is installed at minimum distance from roof edge to meet code requirements.
- B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in place, bearings lubricated and the fan has been run under observation.
- C. Roof mounted fans and gravity roof-top intake and relief vents shall be secured to the curb with stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x 1/4" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.

- D. Install curbs and equipment in level position.
- E. Ceiling mounted in-line centrifugal blowers
 - 1. Shall be suspended from structure with 1/2-inch zinc plated all-thread rods secured to structure.
 - 2. Provide sub-structure where required.
 - 3. Mount bottom of fan no more than 18-inches above the finished ceiling height.

3.02 EXTRA MATERIALS

- A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag set to identify fan.

END OF SECTION 23 34 16

SECTION 23 37 13
AIR DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

1.02 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.
 - 3. Electrical Requirements for Mechanical Work.

1.03 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.04 SUBMITTALS

- A. Submit product data for outlets, grilles, registers, control devices, and similar equipment for review prior to placement of purchase order.
- B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.

1.05 FINISHES

- A. Paint exposed devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 - PRODUCTS

2.01 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

2.02 ACCEPTABLE MANUFACTURERS

- A. Titus.
- B. Krueger.
- C. Nailor Industries.
- D. Price
- E. Metal-Aire

2.03 ACCESSORIES

- A. Supply Grille Extractors. Provide supply grilles with an air control device capable of positively regulating the volume of air extracted from the supply duct.

Select extractors similar to Titus Model AG25, tight-closing in the minimum position. Include a key-operated or worm-gear adjusting mechanism to facilitate positioning from the grille opening. Where adjustment is not accessible at the grille opening, provide a square control rod equipped with a locking quadrant.

- B. Mounting Frames. Provide each grille or register not equipped with a removable core with a companion, all-purpose mounting frame constructed like grille frame to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.

1. Furnish frames with 1/2" thick sponge rubber gasket to prevent air leakage.
2. Provide a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return-air blank-off strips and flexible duct have been approved. Remove and reinstall any part of the installation found incorrect.

3.02 INSTALLATION

- A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws. For perforated diffusers, attach the frame assembly by a concealed hinge assembly to an outer frame compatible with the type of ceiling on which the diffuser is installed.

END OF SECTION 23 37 13

SECTION 23 41 00
AIR FILTRATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install air filters and air filter gauges.

1.02 RELATED WORK

- A. Division 23 Mechanical.

1.03 SUBMITTALS

- A. Submit manufacturer's product data sheets and capacity information as specified.
- B. Submit recommended Dirty Filter pressure drop.

PART 2 - PRODUCTS

2.01 AIR FILTER GAUGES

- A. Install an air filter gauge as specified for each air handling unit and heat pump indoor fan/coil unit. (Not perimeter heating fan/coil units.)
 - 1. Mount to take pressure differential across each filter bank.
 - 2. Locate to be easily read from 5'-6" eye level.
- B. Install filter gauges on:
 - 1. Each constant volume air handling unit.
 - 2. Each heating/cooling fan/coil unit.
 - 3. Two selected plenum heater fan/coil units.
- C. Provide with range appropriate to the filter manufacturer's recommendation for maximum pressure drop across the filter.
- D. Filter gauge shall be Dwyer Series 3000 Photohelic.
 - 1. Static pressure tips.
 - 2. Sensing tubing.
 - 3. Adjustable alarm signal flag.
 - 4. Auxiliary contacts for remote monitoring.
- E. Filter gauge shall be Dwyer Series 2000 Magnahelic:
 - 1. Static pressure tips.
 - 2. Sensing tubing.
 - 3. Adjustable alarm signal flag.
- F. Set alarm signal flag and auxiliary contacts as recommended for maximum pressure drop Dirty Filter across the filter bank.
- G. Mount the filter gauge on a rigid structural bracket on the unit.

2.02 AIR FILTERS

- A. The filter cells:
 - 1. Permanent frame with renewable media.
 - 2. 18-gauge galvanized steel holding frame.
 - 3. 11-gauge galvanized steel wire grids to support the media.
 - 4. Front grid hinged and secured with a latch.
- B. The renewable viscous coated glass fiber media:
 - 1. Graduated density from front to back.
 - 2. Initial resistance not to exceed 0.17" WG at 500 fpm velocity.
 - 3. UL listed Class II.
- C. Acceptable manufacturers:
 - 1. Cam-Farr.
 - 2. AAF.
- D. Spare filter:
 - 1. Provide the following material to the Owner for use during the warranty period.
 - 2. Sufficient media of each thickness, in original cartons, for a complete change.

2.03 AIR FILTERS

- A. Filter cells:
 - 1. Permanent, impingement, washable.
 - 2. Metal, panel type.
 - 3. Electro galvanized 14 mesh steel screen media arranged in alternate layers of flat and herringbone-crimp screens, 4 layers of each per inch.
 - 4. 1/8" rod reinforced.
 - 5. Enclosed 16 gauge galvanized steel frames.
 - 6. Coated with high flash point adhesive.
- B. Resistance to air flow of clean filter not to exceed 0.10" WG at 500 fpm.
 - 1. Maximum face velocity 500 fpm.
- C. Provide one complete set of spare filters for each unit.

2.04 AIR FILTERS

- A. The filter cells:
 - 1. Disposal media and frame.
 - 2. Coated with high flash point adhesive.
- B. Resistance to air flow of a clean filter not to exceed 0.12" WG at 300 fpm.
- C. UL listed Class II rated.

2.05 MEDIUM EFFICIENCY AIR FILTERS

- A. The filter cells:

1. Pleated media.
 2. Disposable type.
 3. Contain not less than 4.6 sq. ft. of filtering media per square foot of face area.
 4. 16 pleats per linear foot of filter.
 5. 2" thick.
- B. Media of reinforced nonwoven cotton fabric treated with adhesive and continuously laminated to a supporting steel wire grid conforming to the configuration of the pleats.
1. Seal the media pack in a chipboard frame.
- C. Rated average dust spot efficiency of not less than 36%.
1. Average synthetic arrestance in excess of 93% when tested in accordance with the ASHRAE 52-68 test standard.
- D. Filter capable of operating with variable face velocities up to 500 fpm without impairing efficiency.
- E. Initial resistance to air flow:
1. 300 fpm - 0.12" WG.
 2. 500 fpm - 0.28" WG.
- F. UL listed with Class II rating.
- G. Provide one spare set for a complete change, in original cartons, for Owner's use during the warranty period.

2.06 HIGH EFFICIENCY AIR FILTERS AND HOUSING

- A. Air filter module:
1. Dry type.
 2. With a permanent galvanized steel holding frame.
 3. Replaceable filter cartridge.
 4. Pre-filter cell.
- B. Filter efficiency shall be rated on atmospheric dust by the dust spot test method in accordance with ASHRAE Standard 52-76.
1. The average efficiency of the filter shall be as scheduled.
- C. Filter housing:
1. Factory assembled of 16-gauge galvanized steel with turned down flanges to provide a flush exterior.
 2. Integral pre-filter section.
 3. Furnished with a door at each end.
 4. Access to only one side shall be required for filter servicing.
 5. Doors shall utilize:
 - a. Perimeter gaskets of neoprene rubber.
 - b. Quick acting, spring-loaded and non-corrosive latches.
 - c. Plated hinges.
 6. Filter mounting tracks shall be of extruded aluminum with factory-installed gaskets of molded PVC.
 - a. Sealing pressure applied with a toggle and cam mechanism.

- b. Integral pre-filter track for 2" pre-filters.
 - 7. American Air Filter "Serviside" with lever lock seal.
- D. The filter cartridge shall consist of filter media attached to a rigid, rust inhibiting steel header.
- E. Filter media and header shall be factory sealed against leakage by cementing the media to the header.
 - 1. Cartridges shall be collapsible.
 - 2. Fireproof media UL listed Class II.
 - 3. American Filter "Dri-Pak".
- F. Pre-filter cells:
 - 1. Renewable media type.
 - 2. 18-gauge galvanized steel holding frame.
 - 3. 11-gauge galvanized steel wire grids to support the media.
 - 4. Front grid hinged and secured with a latch.
 - 5. Filter media:
 - a. Viscous coated glass fiber.
 - b. 2" thick.
 - c. Graduated density from front to back.
 - d. Flame proof UL listed Class II.
 - 6. American Air Filter "Renu".
- G. Pre-filter cells:
 - 1. Disposal media and frame.
 - 2. Coated with high flash point adhesive.
 - 3. UL listed Class II rated.
 - 4. American Air Filter 5700 Industrial.

2.07 ACTIVATED CARBON AIR PURIFICATION FILTER

- A. Air purification filters module:
 - 1. Perforated, activated carbon filled, multiple-element, gas and odor absorption cells.
 - 2. Uniform carbon bed thickness throughout.
 - 3. Cell elements arranged so that air to be purified will pass uniformly through the carbon.
 - 4. With a permanent galvanized steel holding frame.
 - 5. Replaceable carbon trays.
 - 6. Pre-filter cell.
- B. Filter housing:
 - 1. Factory assembled of 16 gauge galvanized steel with turned down flanges to provide a flush exterior.
 - 2. Integral pre-filter section.
 - 3. Furnished with a door at each end.
 - 4. Access to only one side shall be required for tray removal.
 - 5. Doors shall utilize:
 - a. Perimeter gasket of neoprene rubber.
 - b. Quick acting, spring loaded and non-corrosive latches.

- c. Plated hinges.
- C. Pre-filter
 - 1. 2" thick.
 - 2. Disposable media and frame as specified.
- D. The filter shall contain approximately 45 lbs. of activated carbon per 1,000 cfm.
- E. Provide a detachable test element.
 - 1. When returned to the manufacturer after a specified period of operation, will indicate the service life remaining.
- F. Provide a charcoal filter management and service program for a period of one year from substantial completion of the system to include the following:
 - 1. Send the test element to the filter manufacturer for evaluation of service life remaining.
 - 2. Provide review of report and evaluation on testing.
 - 3. Establish the recommended schedule for analysis and evaluation of the future test element program.
 - 4. Provide for training of operating personnel.
 - 5. Insert all information in the Owner's operating manuals.
- G. Capacity as scheduled on the drawings.
- H. Provide one complete set of spare trays loaded with fresh carbon for the Owner's use after the warranty period.

2.08 OUTSIDE AIR PURIFICATION SYSTEM

- A. Filter and fan section cabinet construction:
 - 1. All stainless steel construction including screws.
 - 2. Gasketed, hinged side access doors with 1/4 turn cam handle latches.
 - 3. Weatherproof construction suitable for outdoor installation.
- B. Staged filtration shall consist of a 30% efficient pre-filter, (2) pass chemical filter and a 90% efficient after filter.
- C. Fan shall be sized for 1,245 CFM and 3-1/2" W.C. total static pressure.
 - 1. Belt drive with adjustable sheave.
 - 2. 3.0 HP
 - 3. 480-3-60 current characteristics.
- D. Purafil Model #304-892P12M12M-5F-BLR with (2) 300lb Purafil II Chemisorbant media banks.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the filters and filter gauges in accordance with the manufacturer's instructions.

END OF SECTION 23 41 00

SECTION 23 52 35
GAS-FIRED MODULATING HOT WATER BOILER (Condensing)

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. This section specifies a packaged gas-fired stainless-steel condensing firetube boiler complete with all controls and trim for indoor installation.
- B. Each boiler shall be provided with all components, accessories and appurtenances necessary for a complete and operable boiler, as hereinafter specified, in one complete package. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.
- C. Each factory packaged boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

1.02 RELATED WORK

- A. Division 23- Mechanical
 - 1. Hot Water Piping
 - 2. Gas Piping
 - 3. Ductwork

1.03 PERFORMANCE

- A. Provide performance as scheduled on drawings. Boilers shall be certified for up to 98% efficiency.

1.04 WARRANTIES

- A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of eighteen (18) months from date of substantial completion. Heat exchanger and fuel burner shall be warranted for a period of five (5) years from date of substantial completion.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Fulton
- B. Aerco

C. Lochinvar

D. Camus

2.02 PERFORMANCE CRITERIA

- A. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 92 % on 500 MBH input boilers and less and not less than 95% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68° F.
- B. Boiler shall comply with ASME Section IV for 80 psig, max 200° F (100 psig on 1500 MBH and larger units).
- C. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 inch WC to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 inch WC.
- D. Boilers shall be certified for low NOx by the TCEQ. NOx emissions shall not exceed 30 PPM when referenced at 3% O2 at all firing rates.
- E. The burner, gas train and controls shall conform to the requirements of G.E. Global Asset Protection (GAP) Services.

2.03 BOILER DESIGN

- A. Each hot water boiler shall consist of a vertical stainless-steel firetube heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system such that the required capacities, efficiencies, and performance is provided as specified/scheduled.
- B. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.
- C. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16 gauge carbon steel. The complete outer casing shall be finished, inside and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 50°F above ambient temperature when the boiler is operated at full rated load.
- D. Boiler shall have a single condensing heat exchanger. A boiler that utilizes a secondary condensing heat exchanger is unacceptable.
- E. An observation port shall be located on the boiler to allow for observation of the burner flame.
- F. Boiler heat exchanger headers shall be fabricated steel and be completely removable for inspection. Seals shall be EPDM, rated for 400 deg F service. Push nipples or gaskets

between the sections are not permitted.

2.04 BOILER TRIM

- A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
 - 1. Safety relief valve shall be provided in compliance with the ASME code. Contractor is to pipe to acceptable drain.
 - 2. Water pressure temperature gauge.
 - 3. Primary low water flow fuel cutoff (probe type with manual reset).
 - 4. Manual reset high limit water temperature controller.
 - 5. Operating temperature control to control the sequential operation of the burner.
 - 6. Separate inlet and outlet water temperature sensors capable of monitoring flow
 - 7. Exhaust temperature sensor
 - 8. Provide condensate neutralization kit (shipped loose).

2.05 BOILER FUEL BURNING SYSTEM

- A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic modulating fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system to provide the required capacities, efficiencies, and performance as specified/scheduled.
- B. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.
- C. Each burner shall be radial-fire type with metal fiber mesh. All burner material exposed to the combustion zone shall be of stainless steel construction.
- D. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall operate at 6000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the text based display.
- E. Each boiler shall be provided with a "Full Modulating" firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100%

2.06 IGNITION SYSTEM

- A. Each boiler shall be equipped for direct spark ignition.

2.07 BOILER CONTROL SYSTEM

- A. The boiler control system shall have the following capabilities at a minimum:
 - 1. Maintain single set point
 - 2. Reset the set point based on outdoor air temperature

3. Boiler shutdown based on outdoor air temperature
 4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)
 5. Alarm relay for any for any manual reset alarm function.
 6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.
 7. Local Manual Operation.
 8. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of integrating to a BMS
 9. Computer (PC) interface for programming and monitoring all functions
- B. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:
1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.
 2. One (1) low airflow differential pressure switch to insure that combustion air is supplied.
 3. High exhaust back pressure switch
- C. Each boiler shall be provided with an integral burner control system. The burner control system shall be factory assembled and shall include the following:
1. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The 120/1/60 power supply to each boiler shall be protected by a circuit breaker sized per the manufacturers recommendations (supplied by contractor).
 2. The boiler shall include an electric spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.
 3. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.
 4. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.
- D. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
1. One (1) burner "on-off" switch.
 2. One (1) electronic combination temperature control, flame safeguard and system control.
 3. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.
 4. Text Based Display Panel to adjust set points and control operating parameters. Text Based Display is to indicate burner sequence, all service messages, fan speed, boiler set point, and sensor values such as inlet temperature, outlet temperature, flue gas and outdoor air temperature

2.08 FACTORY TESTING - HYDROSTATIC

- A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME "H" stamp.

2.09 SEQUENCE CONTROLLER

- A. Boiler shall be provided with a boiler sequence controller that is capable of controlling
 1. One or multiple boilers
 2. All condensing or all non-condensing boiler
 3. Combination of condensing and non-condensing boilers (hybrid system).
 - a. When controlling hybrid systems, sequence controller shall sequence the lead boiler based on its condensing capabilities to provide the most efficient operation.
 4. Controller shall be capable of communicating via MODBUS protocol.
 5. Controller shall allow boiler or boilers to operate via a remote header sensor (header sensor provided by boiler manufacturer, installed by contractor).
 6. Controller shall be capable of allowing boiler or boilers to operate based on outdoor reset. This shall be achieved by either:
 - a. Programming the controller with an outdoor air reset curve in conjunction with a separate outdoor air sensor (outdoor sensor shall be provided by boiler manufacturer, installed by contractor),
 - b. Setpoint control via 0-10 VDC analog communication with building automation system,
 - c. Setpoint control via MODBUS communication.
 7. Controller shall visually display relay status, firing rate of each boiler, header temperature, outdoor air temperature. Coordinate wiring of this controller with mechanical and control's contractor.

2.10 CARBON MONOXIDE MONITORING SYSTEM

- A. Provide and install a manual reset Carbon Monoxide Detector located within the boiler room when combustion air is ducted to boilers. The Carbon Monoxide Detector and the boilers shall be interlocked so that the burners will not operate when the level of CO in the room rises above 100ppm. The Carbon Monoxide detector shall disable the boiler's burner upon loss of power to the detector.
- B. Carbon Monoxide Sensor with two year warranty by U.S. Draft Co. Model CGM-505 with model XB expansion module.
 1. Provided with pre-programmed dry contacts to shut down equipment during unsafe operation.
 2. NEMA 1 Enclosure
 3. Additional features shall include 0-10 VDC control signal out, visual alarm and audible alarm.
 4. Provide expansion board for additional equipment interlocks.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install isolation valves and unions on supply and return water lines to boiler.
- B. Install strainer, drain with valve, pressure and temperature gauge on return water line to

boiler.

- C. Install main gas cock, drip leg and union close to boiler.
- D. Install on 4" concrete pad and place into operation in accordance with manufacturer's instructions. Pipe as detailed on drawings.
- E. Provide Category IV vent stack material. Mechanical contractor shall coordinate draft requirements and other venting requirements between stack supplier and boiler supplier.
- F. Install boilers, piping and accessories in accordance with the manufacturer's installation instructions and state boiler code.
- G. Pipe each gas relief vent to the outdoors, in accordance with the manufacturer's recommendations and the local codes.
- H. Contractor to route condensate connection off of boiler and stack to acid neutralization kit and then to appropriate drain. Trap as required by boiler manufacturer.

3.02 BOILER MANUFACTURER STARTUP SERVICE

- A. Provide factory authorized startup services to assure its proper operation.
- B. Set the boiler operating and safety controls.
- C. Perform a flue gas analysis at the boiler outlet. Record the following results of the analysis:
 - 1. Carbon dioxide percent volume.
 - 2. Oxygen percent volume.
 - 3. Stack temperature.
 - 4. Calculated combustion efficiency.
- D. Do not operate the boiler for any reason until the factory startup service has been completed.
- E. Startup procedure shall include a functional test of Carbon Monoxide Detector. Simulate an alarm condition and demonstrate the functionality of the detector shutting down the appliances. Owner/Engineer shall be present to witness test.

END OF SECTION 23 52 35

SECTION 23 63 00
AIR-COOLED CONDENSING UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.02 RELATED WORK

- A. Refrigerant Piping.
- B. Electrical Provisions of Mechanical Work.

1.03 PERFORMANCE

- A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Trane
- C. Daikin
- D. York

2.02 COMPRESSOR

- A. Provide a hermetic or semi-hermetic compressor with crankcase heaters, inherently protected motors, spring mounts and capacity modulation. Provide each compressor with a 5-year warranty.
- B. Provide refrigerant not scheduled for phase out during the life of the unit.

2.03 CONDENSER COILS

- A. Provide copper tubes with mechanically bonded aluminum fins. Protect condenser coils with a heavy gauge, corrosion resistant wire guard.
- B. Provide condenser coil coated with corrosion resistant epoxy utilizing a dip and bake process. Coating shall be flexible and uniformly bonded to all condenser coil surfaces.

2.04 FANS AND MOTORS

- A. Provide propeller-type fans with direct drive or belt drive and vertical discharge. Protect fan with a heavy-gauge, corrosion resistant wire guard. Provide inherently protected, permanently lubricated, and weatherproof motors.

2.05 CASING

- A. Furnish a unit designed for outdoor mounting. Fabricate the casing of heavy gauge steel, zinc coated and finished with enamel. Provide removable access panels.

2.06 CONTROLS

- A. Provide safety and operating controls factory wired and mounted in a separate enclosure. Include thermostatic expansion valve, high and low pressure switches and compressor motor overload devices. Furnish a time delay device to prevent short cycling. Employ a control transformer, a pressure relief device and suction and discharge valves with service connections.

2.07 THERMOSTAT

- A. Low voltage, 7-day programmable thermostat is a component of the unit manufacturer unless specified in another Section.
 - 1. Individual Heating/Cooling setpoints.
 - 2. Automatic Heat/Cool change-over.
 - 3. Sub-Base On-Off-Auto fan selection.
 - 4. Sub-Base Heat-Off-Cool-Auto system selection.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install removable core refrigerant filter dryer and sight indicating glass.

3.02 CONTROL WIRING

- A. Furnish and install control wiring as required. Install control wiring in conduit.

END OF SECTION 23 63 00

SECTION 23 74 15
PACKAGE ROOFTOP VARIABLE VOLUME AIR CONDITIONERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide and install a package, variable volume electric air conditioner for rooftop application.

1.02 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.
 - 3. Electrical provisions of mechanical work.
 - 4. Air filtration.
 - 5. Variable Volume Terminal Units.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Carrier.
- B. York.
- C. Trane.
- D. Daikin

2.02 COMPRESSOR

- A. Provide a thermally protected, serviceable semi-hermetic compressor or hermetic compressor with service valves, vibration isolation, crankcase heaters, sight glass and filter drier. Provide with a 5-year warranty. Unit shall be provided with hot gas by-pass.

2.03 EVAPORATOR AND CONDENSER COILS

- A. Provide copper tubes with mechanically bonded aluminum fins for evaporator and condenser coils.
- B. Intertwined evaporator coil.

2.04 EVAPORATOR FANS

- A. Provide a belt-driven, forward-curved, centrifugal evaporator fan, with adjustable motor sheaves. Motor shall contain permanently lubricated bearings. Provide motor HP as indicated on the drawings.
- B. Variable inlet vane dampers
 - 1. Damper operator as specified in Section 23 09 33.

2.05 CASING FILTERS AND DUCT CONNECTION

- A. Provide a cabinet constructed of galvanized or zinc-coated steel, primed and coated with baked enamel and suitable for outdoor installation.
- B. Provide duct connections on the bottom of each unit, or as indicated on drawings.
- C. Provide manually operated outdoor air dampers.
- D. Furnish 2" thick filters as specified.

2.06 ROOF CURB

- A. Install a roof curb of the same manufacture as the air conditioning unit.
 - 1. Curb to support the unit and provide a watertight enclosure to protect ductwork and utility services.
 - 2. Use a design complying with National Roofing Contractors Association requirements.
 - 3. Level curb according to manufacturer's recommendations.
 - 4. Side discharge adapter where required.

2.07 OUTDOOR FANS

- A. Provide propeller type with direct-driven permanently lubricated motor. Fan shall discharge upward.

2.08 HEAD PRESSURE CONTROL

- A. Provide solid state outdoor air fan speed control to permit unit to operate down to 15 degrees F.

2.09 SHORT CYCLE CIRCUIT

- A. Controls to prevent the compressor from short cycling as a result of a rapid change in thermostat setting. Circuit also prevents compressor restart at least 5 minutes after shutdown.

2.10 CONVENIENCE OUTLET

- A. 115V outlet in unit cabinet.

2.11 OUTSIDE AIR INTAKE AND DAMPER

- A. Outside air intake hood complete with manual balancing damper and motorized shut off damper.
 - 1. Interlock the damper to open/close whenever the unit evaporator fan is energized.
 - 2. Damper operator as specified in Section 23 09 33.

2.12 CONTROLS

- A. Controls shall be factory mounted and tested.

- B. Discharge air controller shall stage the cooling capacity as required to maintain discharge temperature.
 - 1. Mount temperature sensor in a location accessible for servicing.
- C. Duct mounted static pressure sensor shall modulate the variable inlet dampers to maintain required system static pressure.
 - 1. Damper operator as specified in Section 23 09 33.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install according to manufacturer's recommendations and as shown on drawings.
- B. Unit is to be provided with a through-the-bottom service connection accessory package and must be used for electrical connections to unit. Use bulkhead connectors to make a waterproof connection.
- C. Seal all duct connections to roof curb for air tight connection. Install a 90 degree flanged ductwork connection to the roof curb. Provide and install gasketing around duct flanges. Provide and install gasketing around outer edge of roof curb.
- D. Coordinate requirement and installation with specification Section 23 09 33 "Building Management and Control System".

END OF SECTION 23 74 15

SECTION 23 81 18
SINGLE PACKAGE ROOFTOP AIR CONDITIONERS (DOAS)

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide and install a single-package, single-zone, electric air conditioner with SCR electric heat for 100% outside air in a rooftop application.

1.02 PERFORMANCE

- A. Provide performance as scheduled on drawings.

1.03 QUALITY ASSURANCE

- A. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- B. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
- C. System Seasonal Energy Efficiency Ratio/Energy Efficiency Ratio (SEER/EER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
- D. Unit shall be safety certified by ETL and be ETL US listed.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Literature shall be provided that indicates dimensions, operating and shipping weights, certified capacities, ratings, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided.
- B. Shop Drawings:
 - 1. Unit drawings shall be provided that indicates assembly, unit dimensions, construction details, service and air flow clearances, and connection details. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.
- C. Submit coordination drawings as specified. Give consideration to adjacent structures as they affect air flow patterns.
- D. Submit sequence of operation in narrative form.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be shipped with doors bolted shut to prevent damage during transport and

thereafter while in storage awaiting installation.

- B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

1.06 WARRANTY

- A. Manufacturer shall provide a parts and labor warranty for a period of 1 year from the date of substantial completion. Warranty excludes parts associated with routine maintenance and refrigerant.
- B. Compressor shall be provided with a 5 year non-prorated parts and labor warranty including recharging refrigerant system.
- C. Stainless steel heat exchanger shall be provided with a minimum of a 10 year non-prorated parts warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. AAON
- B. Daikin Applied
- C. Trane

2.02 COMPRESSOR

- A. Compressors shall be a fully modulating digital scroll or variable speed scroll type with thermal overload protection, independently circuited and shall be capable of modulation from 10-100% of its capacity and allow for airflow turn down to 30% of full flow.
- B. Each compressor shall include a crankcase heater.
- C. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to the compressors.
- D. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
- E. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high-pressure and low-pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided. Finished field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal

expansion valve, liquid line, insulated hot gas bypass line, insulated hot gas and suction lines.

- F. Unit shall include a factory holding charge of R-410a refrigerant.
- G. Each compressor shall be equipped with a 5 minute off, delay timer to prevent compressor short cycling.
- H. The unit shall be capable of stable cooling operation to a minimum of 35°F outdoor temperature.
- I. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal.
- J. Provide each compressor with a Removable Sound Cover that is constructed of a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.3 density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with “D” rings and Velcro fasteners. The inner and outer jackets shall protect against UV rays, oil and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified equipment. Manufactured by BRD Noise and Vibration Control or engineer approved equal.

2.03 EVAPORATOR, CONDENSER AND REHEAT COILS

- A. Provide the evaporator and hot gas reheat coil constructed of copper tubes with mechanically bonded aluminum fins and stainless-steel end casings.
- B. Provide the condenser coil constructed of an aluminum microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannel layered between the refrigerant manifolds.
- C. Provide an evaporator coil with interlaced circuitry. Provide a minimum of 12” clearance downstream of the evaporator and hot gas reheat coils.
- D. Provide factory installed louvered hail / vandalism guards for condenser coils.
- E. Provide coils with stainless steel casings, end plates, tube supports and top and bottom plates.
- F. Provide the condenser coil coated with corrosion resistant epoxy utilizing a dip and bake. Coating shall be flexible and uniformly bonded to all condenser coil surfaces and shall meet a minimum of 6,000 hours corrosion resistance per ASTM B117.
- G. Provide hinged access doors with quick release handle adjacent to each coil for inspection and maintenance.
- H. Provide condenser coils coated with corrosion resistant epoxy utilizing a dip and bake. Coating shall be flexible and uniformly bonded to all condenser coil surfaces.

2.04 EVAPORATOR FANS

- A. Unit shall be equipped with a direct drive, backward curved airfoil blade, centrifugal evaporator fan.
- B. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
- C. Motor shall contain premium efficiency TEFCP with self-aligning ball bearings rated for 200,000 hours service with external lubrication ports grouped near the motor access side of the unit.
- D. Provide motor HP as indicated on the drawings.

2.05 ELECTRIC HEATING

- A. High nickel chrome alloy resistance wire
 - 1. Mechanically staked and welded to corrosion-resistant terminals.
 - 2. Manual and automatic temperature control devices.
- B. Provide minimum of 3 stages of heat
 - 1. Stages shall be balanced
- C. Provide Silicon Controlled Rectifier (SCR) control to provide infinite capacity adjustment

2.07 CASING, FILTERS AND DUCT CONNECTION

- A. Provide a cabinet constructed of galvanized or zinc-coated steel, primed and coated with baked enamel and suitable for outdoor installation. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B117-95 test procedure.
- B. Unit shall be equipped with duct connections on the bottom of each unit, as indicated on drawings.
- C. Provide two-position, motorized spring return outdoor air damper constructed of extruded aluminum air foil blades with rubber edge and end seals. Damper assembly shall be Class 2 AMCA Certified.
- D. Unit shall be equipped with an outside air hood with a minimum of 1" thick aluminum mesh pre-filters.
- E. Unit shall be equipped with a filter frame
- F. Provide with stainless steel polymer condensate drain pan with positive slope in all directions to outlet.
 - 1. Externally line the condensate drain pan with 1-1/2" waterproof insulation.
 - 2. Provide a hinged access door with quick release handle adjacent to condensate drain pan for inspection. Install access door on drain connection side of unit.
 - 3. Drain pan shall be insulated with a minimum 2' thick foam insulation.

- G. Double wall casing construction
1. Construct roof, wall, and floor with minimum 2-inch-thick, 2 lb. density, R-13 injected polyurethane foam insulated, double wall panels with thermal break for superior energy efficiency and casing longevity.
 2. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
 3. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
 4. Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors. Units without full hinged access doors in the cooling coil section are not acceptable.
- H. Furnish through-the-curb electrical service connection.

2.08 CONTROLS

- A. Provide safety and operating controls factory wired and mounted in an integral controls and electrical enclosure. Include thermostatic expansion valve, high and low-pressure switches and compressor motor overload devices. Furnish a time delay device to prevent short cycling. Employ a control transformer, a pressure relief device and suction and discharge valves with service connections. Include a high condensate level switch that shuts down the unit when a high-water level is detected in the drain pan.
- B. Unit shall be provided with a fully functional DDC control system with BACnet MS/TP or LonWorks integration. BCMS system shall have the ability to remotely start/stop the unit, adjust supply air temperature heating and cooling setpoints, and adjust targeted supply air dew point setpoint during dehumidification mode.
1. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 2. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 3. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
 4. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller

shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network.

2.09 ROOF CURB

- A. Install a welded roof curb:
 - 1. Curb shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
 - 2. Use a design complying with National Roofing Contractors Association requirements.
 - 3. Level curb according to manufacturer's recommendations.
 - 4. Curb height shall be a minimum of 14".
 - 5. The assembly of the unit and roof curb shall be rated for a minimum of 150 MPH winds. Provide engineered drawings certifying this requirement is met.
 - 6. Curb shall be a spring isolation type

2.10 OUTDOOR FANS

- A. Unit shall be equipped with a direct drive propeller type fan with permanently lubricated TEFC motor. Fan shall discharge upward.
- B. Condenser fans shall be VFD driven variable speed for active condenser head pressure control.

2.11 CONVENIENCE OUTLET

- A. Provide factory installed 120V, 20 amp GFI outlet in unit cabinet.
 - 1. Outlet shall require field supplied 120 volt power
 - 2. Outlet shall **not** be on the same electrical circuit as the associated packaged unit.

2.12 SERVICE DISCONNECT SWITCH

- A. Unit shall be equipped with a factory installed field wired, circuit breaker with external locking handle.

2.13 TEMPERATURE CONTROL

- A. Unit shall be controlled by maintaining a constant supply air temperature as scheduled on the drawings. When the outside air temperature drops below the scheduled leaving air temperature, the unit shall enter heating mode and the heater shall modulate to maintain the heating mode supply air temperature setpoint. When the outside air temperature is above the scheduled supply air temperature, the unit shall enter dehumidification priority mode, the compressor capacity shall be modulating to maintain the active evaporator coil temperature setpoint and the modulating hot gas reheat valve shall be controlled to maintain

the cooling mode supply air temperature setpoint. The evaporator coil temperature must be controlled by the use of suction pressure transducers installed on each refrigeration circuit. The use of an evaporator coil temperature sensor is not allowed. The unit shall be able to independently control the supply air dry bulb and wet bulb temperatures under all OA loads during cooling mode. Open outside air damper prior to starting fan and close damper during unoccupied mode.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install according to manufacturer's recommendations and as shown on drawings.
- B. Installing contractor shall install field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

3.02 START UP

- K. Provide unit with a factory start up performed by a factory certified technician. Start-up services shall include installation inspection, controls wiring inspection, assistance with BAS controls terminations in unit control cabinet, programming specified sequence of operation, BAS integration, and owner training.

END OF SECTION 23 81 18

SECTION 23 82 18
DUCTLESS MINI SPLIT DX UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install mini split system. Complete with a slim silhouette, compact, high wall mounted indoor fan coil section with wireless remote controller and a slim silhouette horizontal discharge outdoor condensing unit. Unit shall be provided with constant speed compressor, pre-charged with R410A refrigerant. air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.02 RELATED WORK

- A. Refrigerant Piping.
- B. Electrical Provisions of Mechanical Work.

1.03 PERFORMANCE

- A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

1.04 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 Quality assurance Standards and ISO 14001 which are set of standards applying to sustainability and environmental protection set by the International Standard Organization (ISO).
- E. A pressure charge of R410A refrigerant sufficient for up to twenty-five (25) feet of refrigerant tubing shall be provided in the outdoor condensing unit.
- F. A dry air holding charge shall be provided in the indoor section.
- G. System efficiency shall meet or exceed 13.0 SEER.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Carrier

- B. Trane
- C. Mitsubishi Electric

2.02 INDOOR UNIT GENERAL

- A. The indoor shall be factory assembled, wired and run tested. Contained within the unit cabinet shall be all factory wiring, internal piping, electronic control circuit board and fan with fan motor.
- B. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and auto restart after power interruption function, an emergency operation function and a test run switch.
- C. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory. All refrigerant piping must be insulated.

2.03 UNIT CABINET

- A. The casing shall have a smooth front, top return, in a Munsell No. 1.0Y 9.2/0.2 white finish.
- B. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
- C. There shall be a separate installation plate which secures the unit firmly to the wall. Secure mounting of plate and all mounting hardware shall be furnished by and be the responsibility of the installer.

2.04 FAN

- A. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor mounted in rubber motor mount.
- B. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- C. Manual adjustable vertical guide vanes shall be provided with the ability to change the airflow from side to side (left to right).
- D. An integral, motorized, horizontal air sweep flow louver shall provide an automatic change in airflow by directing the air up and down to provide for uniform air distribution.
- E. The indoor unit fan motor shall operate in four (4) selectable speeds, Powerful, High, Medium, and Low.

2.05 FILTER

- A. Return air shall be filtered by means of easily removed, washable, Catechin air filter and an anti-allergy enzyme filter – blue bellows type.

2.06 COIL

- A. The indoor unit (evaporator) coil shall be of nonferrous construction with smooth, pre-coated aluminum fins on copper tubing.
- B. Tubing shall have inner grooves for high efficiency heat exchange.
- C. All tube joints shall be brazed with PhosCopper or silver alloy.
- D. The coil shall be pressure tested at the factory.
- E. A sloped condensate pan and drain with extension hose shall be provided under the coil. Drain connections shall be provided at each end of the drain pan. (Option: A condensate mini-pump shall be provided to provide a means of condensate disposal when a gravity drain is not available.)

2.07 ELECTRICAL

- A. Power for the indoor unit shall be supplied from the outdoor unit via Mitsubishi Electric A-Control using three (3) fourteen (14) gauge AWG conductors (N, L1, 2) plus ground wire connecting the units.
- B. Power supply shall be 115 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 103 volts to 127 volts. Wiring shall be 14.
- C. The unit shall be equipped with Mitsubishi Electric's micro-processor control system directing indoor and outdoor unit coordinated operation.
- D. The indoor unit shall not have any supplemental electrical heat elements.

2.08 CONTROL

- A. This system shall have a wireless remote controller to perform input functions necessary to operate the system. The controller shall consist of a Power On / Off switch, Mode Selector, Temperature Setting, Timer Control, Fan Speed Select and Auto Vane Selector.
- B. Temperature changes shall be by 1°F increments with a range of 65°F to 87°F.
- C. There shall be a 24 hour On / Off timer.
- D. The unit shall have an emergency operation mode to allow operation without the remote controller.
- E. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless remote controller, providing emergency operation and controlling the outdoor unit.
- F. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.

- G. The system shall be capable of automatic restart when power is restored after power interruption.
- H. The control system shall control the operation of the air sweep louvers, as well as provide on / off and system / mode function switching.

2.09 OUTDOOR UNIT GENERAL

- A. The outdoor unit is designed specifically for use with MS series indoor units. These units are equipped with a circuit board that interfaces to the MS indoor unit circuit board. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.
- B. When refrigerant lines are exposed on exterior of building provide "LINE-HIDE" line set cover system.
 - 1. Material, Weather resistant, UV stabilized, ASA/PVC/ABS/Poly/PE
 - 2. Assembly Screws, stainless steel.

2.10 UNIT CABINET

- A. The casing shall be fabricated from zinc coated steel, bonderized with an electrostatically applied, thermally bonded, acrylic or polyester powder coating for corrosion protection.
- B. Case and mounting feet shall be as follows:
 - 1. The MS-A09WA base shall be of Aluminum-Zinc-Magnesium alloy coated steel, with welded mounting feet.
 - 2. The base for the MS-A12WA shall have a galvanized steel base with welded mounting feet.
- C. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

2.11 FAN

- A. The unit shall be furnished with a directive drive propeller type fan, statically and dynamically balanced for smooth and quiet operation.
- B. The fan motor shall have inherent protection, be equipped with permanently lubricated bearings. The fan motor shall be mounted and isolated for quiet operation.
- C. The fan shall be provided with a raised guard to prevent contact with moving parts.
- D. The outdoor unit shall have horizontal discharge airflow.

2.12 COMPRESSOR

- A. The compressor shall be a Mitsubishi Electric high performance, hermetic, rolling piston, rotary type.
- B. Compressor shall be mounted using rubber isolating bushings to avoid the transmission

of vibration.

- C. Compressor shall be protected by an automatic over current relay and a thermal overload switch.

2.13 OPERATION

- A. The outdoor unit shall have an accumulator.
- B. The outdoor unit must have the ability to operate with a maximum height difference of 35 feet between indoor and outdoor units.
- C. The unit shall have a maximum refrigerant tubing length of 65 feet between indoor and outdoor units without the need for line size changes, traps or additional oil. All refrigerant lines must be insulated.
- D. The unit shall be pre-charged for a maximum of 25 feet of refrigerant tubing.

2.14 ELECTRICAL

- A. The electrical power of the system shall be 115 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 103 volts to 127 volts.
- B. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install refrigerant filter dryer and sight indicating glass.
- B. Install units on vibration isolation pads.

3.02 CONTROL WIRING

- A. Furnish and install control wiring as required. Install control wiring in conduit.

3.03 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.
- B. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

3.04 WARRANTY

- A. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from the date of the original installation. The compressor shall have a warranty of

seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

3.05 START-UP

- A. Follow the manufacturer's start-up procedures.
- B. Provide flexible elastomeric rubber closed cell insulation to prevent condensation from occurring on suction piping. After completion of successful start-up, installing contractor shall seal all openings in insulation and apply a protective aluminum sheetmetal jacket over insulation exposed on exterior of building.

END OF SECTION 23 82 18

SECTION 23 82 19
FAN COIL UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Floor mounted decorative cabinet fan/coil units, horizontal fan/coil units for concealed installation and horizontal exposed ceiling mounted fan/coil units with decorative cabinet.

1.02 RELATED WORK

- A. Division 23 Mechanical
 - 1. Air Balance
 - 2. Controls
 - 3. Electrical Provisions of Mechanical Work
 - 4. Ductwork
 - 5. Air filtration

1.03 REFERENCES

- A. ANSI/AHRI 410 - force circulation air cooling and air heating coils
- B. National Electrical Code

1.04 SUBMITTALS

- A. Submit manufacturer's dimensioned product data sheets.
 - 1. Show location of filter access doors.
- B. Submit fan performance curve for each unit:
 - 1. Plot fan volume against static pressure, horsepower and efficiency.
 - 2. Show point of rating based on static requirements of the system.
- C. Submit the fan performance plot at each motor speed position with consideration for the reduced internal static.
- D. Submit a chart of specific sound power level at each octave band center frequency.
- E. Submit manufacturer's certified heating and cooling coil capacity data.
- F. Submit filter manufacturer's product data sheets and capacity information.
- G. Submit manufacturer's data on housing insulation material.

1.05 CAPACITY

- A. Refer to equipment schedule.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. International
- B. Trane
- C. Carrier
- D. Thermal
- E. Bohn
- F. LaSalle
- G. Williams
- H. Daikin
- I. York

2.02 COMPONENTS

- A. Fan section
- B. V-belt drive assembly, or,
- C. Multi-speed direct connected motor
- D. Filter section
- E. Coil section
- F. Insulated sheet metal cabinet with removable panels for access to the interior
- G. Motor and drive inside the cabinet

2.03 FAN SECTION

- A. Locate the motor and drive assembly inside the cabinet.
- B. Size each v-belt drive for 50% overload.
 - 1. Adjustable pitch motor pulley
 - 2. Provide built-in motor protection
 - 3. Belt adjustment means
- C. Provide multi-speed direct connected fan motor with built-in motor protection.
 - 1. Three-speed windings
 - 2. Factory wired to a junction box with provisions for motor speed change, mounted on the box
 - 3. Resiliently mounted

- D. Select the fan motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate amperage rating.
- E. Supply Fans:
 - 1. Double width, double inlet, forward curve blade
 - 2. Statically and dynamically balanced
 - 3. Tested after being installed in the fan section
 - 4. Selected for the design air quantities and static pressure of the system
 - 5. Mounted on a common shaft if multiple wheels
- F. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- G. Fan Bearings:
 - 1. Permanently lubricated
 - 2. Self-aligning

2.04 DECORATIVE HOUSING AND PLENUM

- A. Where units are exposed to view in occupied spaces and where scheduled, construct cabinets of cold rolled steel, bonderized and coated with baked enamel finish.
- B. Access panels shall have position locking fasteners for easy removal.
 - 1. Plated screws with captive nuts
 - 2. Hinged if too large for one man operation

2.05 UNIT HOUSING

- A. Construct the unit of galvanized steel sheets, and formed members.
 - 1. Provide structure to brace the assembly for the pressure of the system.
- B. Bolt housing components together with neoprene gasketed airtight joints.
- C. Internally insulate the entire unit with neoprene coated, 1-1/2 lb. density glass fiber insulation, applied to internal surfaces with adhesive and weld pins. Coat exposed edges of insulation with adhesive.
- D. Insulation, vapor barriers, facings and adhesives:
 - 1. Flame spread not higher than 25
 - 2. Smoke developed rating not higher than 50
- E. Condensation on the exterior of the unit is not approved.
- F. Provide a duct flange on four sides of the return air inlet and supply air outlet of the unit.
 - 1. Sized to permit connection of the flexible connection to the ductwork
 - 2. Extend beyond the primary drain pan
 - 3. Minimum dimension 2"
- G. Provide insulated, removable panels for access to the interior.

1. Plated captive screws and nuts
2. Neoprene gaskets

2.06 CONDENSATE DRAIN PANS

- A. IAQ style drain pans shall be provided under all coils.
 1. Pitch to drain connection
 2. Fabricated from 16 gauge 304 stainless steel
 3. Triple pitched for complete drainage with no standing water
 4. Insulated to prevent condensation
 5. Welded corners
 6. Stainless drain connection

2.07 COILS

- A. Reference Schedule and Specification Section 23 82 16.

2.08 FILTER SECTION

- A. Locate behind access doors.
 1. Construct with substantial hinges
 2. Neoprene gaskets
 3. Permanent quick-release latching devices
- B. Arranged to accommodate the 1" thick filters as specified.
 1. Single section filter
- C. Provide full length tracks to support the filter.

PART 3 - EXECUTION

3.01 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for use after the warranty period.
 1. One spare fan motor for each size of fan motor on the project
 2. One spare set of filters or filter media for each fan coil unit on the project

3.02 ELECTRICAL REQUIREMENTS

- A. Bring electrical connections to a common junction box.

3.03 STORAGE

- A. Storage and shipping in accordance with manufacturer's recommendations.

3.04 INSTALLATION

- A. Install unit so motor connections and filters are accessible.

END OF SECTION 23 82 19

SECTION 26 01 05
ELECTRICAL OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Compile electrical product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare electrical operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit 3 copies of complete manual in final form.

1.02 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Architect / Engineer's stamp of acceptance (including re-submittals), submit for review 1 copy of the first draft of the Electrical Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Architect / Engineer's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Light Fixtures
 - 12. Schedule of Fuses
 - 13. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the (3) completed manuals in final form to the Architect / Engineer.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 - 2. Include all specified data, test reports, drawings, dated warranties, certificates, along with other materials and information.
- D. The Architect / Engineer shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.

- F. Three complete manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.01 BINDERS

- A. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
- B. Minimum ring size: 1".
1. Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.01 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
 2. Format:
 - a. Size: 8-1/2" x 11"
 - b. Text: Manufacturer's printed data or neatly typewritten.
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable
 - c. Identity of general subject matter covered in the manual.
 6. Binder as specified
- B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:

- a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.
 - 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 - 4. Written text as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 - 5. Copy of each warranty, bond and service contract issued
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure
 - 2) Instances that might affect validity of warranties or bonds
 - 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
- 1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) Summer and winter operating instructions
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting
 - 3) Disassembly, repair and reassembly
 - 4) Alignment, adjusting and checking
 - 5) Routine service based on operating hours
 - d. Servicing and lubrication schedule
 - 1) List of lubricants required
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
 - 1) Electrical
 - 2) Controls
 - 3) Communications

- g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear
 - 2) Items recommended to be stocked as spare parts
 - h. Schedule of fuses
 - i. Complete equipment field accessible internal wiring diagrams
 - j. Schedule of light fixtures
 - k. Each Contractor's coordination drawings
 - l. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
 - m. Other data as required under pertinent sections of the specifications
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 - 4. Provide complete information for products specified in Division 26.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.

END OF SECTION 26 01 05

SECTION 26 05 00
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.
- B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.02 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Electrical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department adopted codes with amendments
 - 5. National Electrical Code with local amendments
 - 6. State Regulatory Agencies
 - 7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
 - 8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
 - 9. International Energy Conservation Code
 - 10. National Electrical Safety Code
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.03 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.

2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

1.04 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.
- B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally-Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
 1. Underwriters Laboratories, Inc. (UL)
 2. Factory Mutual Research Corp. (FMRC) (also referred to as "Factory Mutual Global," or "FM Global")
 3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL)
 4. A complete listing of acceptable NRTLs is published on the OSHA website at <http://www.osha.gov/dts/otpc/nrtl/>.
- C. Where material and equipment is not labeled, listed, or recognized by any NRTL, provide a manufacturer's Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.
- D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner's AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.
- E. Codes and Standards applicable to this Division:
 1. ANSI – American National Standards Institute
 2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
 - a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings* [ANSI, IESNA]
 3. ASTM – American Society for Testing and Materials
 4. ICC – International Code Council
 - a. International Building Code® (IBC)
 5. IESNA – Illuminating Engineering Society of North America
 6. NECA – National Electrical Contractors Association
 7. NEMA – National Electrical Manufacturers Association
 8. NETA – International Electrical Testing Association, Inc.
 9. NFPA – National Fire Protection Association:

- a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection*®
- b. NFPA 70™, *National Electrical Code*® (NEC®)
- c. NFPA 70E, *Standard for Electrical Safety in the Workplace*.
- d. NFPA 101®, *Life Safety Code*®
10. OSHA – Occupational Safety and Health Administration
11. IECC – International Energy Conservation Code
12. ISO – International Organization for Standardization
13. Applicable County and Municipal Codes

1.05 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.
- C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.
- D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.
- E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.06 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major

and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.

- B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD and / or Revit CAD files of the original drawings and transfer as-built changes to these.
- C. As-Built Drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's Seal, name, address, and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY:
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.
 - 6. Indicate exact location of all underground electrical raceways, and elevations.
 - 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
 - 10. Exact location of all electrical equipment in and outside of the building.
 - 11. Exact location of all outdoor lighting poles and equipment.
 - 12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 - 13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 14. Cloud all changes.
 - 15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.07 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.08 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
 - 2. The responsibility for alignment of motor and driven equipment is specified in the related division.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.09 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

- A. After all electrical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.16 WARRANTIES

- A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.
- B. Manufacturer's warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.
- C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

- A. General: Refer to Division 1 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 IDENTIFICATION OF EQUIPMENT

- A. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
 - 2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each piece of electrical equipment with stainless steel screws.
 - a. Utility Power: White letters on black background
 - b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "PANEL HA –fed from MDP-6 located in Mech. Rm. 100"). The words "fed from" and "located" shall be included in the labeling.
 - c. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel "HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100")
 - d. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.
 - e. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load,

location of panel serving load, panel and circuit number serving control circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e. C-1.

Lighting Contactor Example	Receptacle Contactor Example
Lighting Contactor C1 West Parking Lot Pole Lights Fed From Panel HA-2,4,6 Located Main Elec. Rm. 100 Control Circuit-Panel LA 42 Located Main Elec. Rm. 100 Controlled-BMCS	Receptacle Contactor C2 Table Recpts Lab Rm 100 Fed From Panel LA-2,4,6,8 Located Mech. Rm. 110 Control Circuit-Panel LA-42 Controlled-Emer Shut Off Mushroom Switch Rm 101

- f. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A
 - g. Above ceiling lighting control relay equipment: Provide name plate glued to bottom of ceiling T-grid below relay location. White letters on black background with 1/4" high letters on 1/2" tall label for digital lighting module "DLM".
3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as "corridors". Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect's final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
 4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
 5. Pull Boxes, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.

- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.
- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.

3.02 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.03 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
 - 3. Refer to other specification sections for additional training and commissioning requirements.
- B. Time to be allocated for instructions.
 - 1. Minimum of 20 hours dedicated instructor time
 - 2. 4 hours on each of 5 days
 - 3. Additional instruction time for specific systems as specified in other Sections.

- C. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- D. The Owner shall provide a list of personnel to receive instructions, and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.04 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.05 HOUSEKEEPING PADS

- A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.
- B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.
- C. Concrete pads:
 - 1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors, or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
 - 2. Chamfer strips at edges and corner of forms.

3. Smooth steel trowel finish.
4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.06 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.07 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.08 TESTING

- A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.
- B. The project will not be declared substantially complete until the following has taken place.
 1. The "As-Built" drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner's Construction Representative.
 2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
 3. Occupancy Sensor and Lighting Controls
 4. Overcurrent devices
 5. Motor Controllers

6. Emergency Lighting
7. Building Fire Alarm System
8. Building Data / Voice Cabling System
9. Surveillance and Security System
10. Intercom / Telephone

END OF SECTION 26 05 00

SECTION 26 05 09
ELECTRIC UTILITY COORDINATION AND SERVICE ENTRANCE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. General: Electrical service shall be provided by local utility company.
- B. Power Company Data: Obtain from utility company information and installation standards for electrical 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

2.01 GENERAL

- A. Service Data: Ensure that utility company service data is accurate and verified.

2.02 PRIMARY SERVICE

- A. General: Division 26 shall provide primary service conduit, concrete transformer pads, concrete ductbank, manholes, and pull boxes as required and as specified.
- B. Utility company shall provide primary cables, splices, terminations, and primary underground and overhead service conductors.

2.03 TRANSFORMERS AND SWITCHGEAR

- A. General: Division 26 shall make provisions for service as required by utility company, including, but not limited to permanent or removable/lockable vehicular barriers, grounding rods, grounding conductors, and sleeves.
- B. The utility company shall provide service transformers, primary switchgear, primary protective relaying, and connections to the customer service.

2.04 SECONDARY SERVICE CONDUCTORS

- A. General: Division 26 shall provide secondary service entrance conductors, conduit and concrete ductbank.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Standards: 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. Correction: 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 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, concrete reinforced ductbanks, conduits, metering racks and metering enclosures.
- E. Utility 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 power provider (retail seller), utility (transmission and distribution), 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 09

SECTION 26 05 19
CONDUCTORS AND CONNECTORS – 600 VOLT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide electrical conductors, wire and connector work as shown, and specified.
- B. Types: The types of conductors and connectors required for the project include the following:
 - 1. 600V building conductors
 - 2. 600V building conductor connectors
- C. Application: The applications for conductors and connectors required on the project are as follows:
 - 1. Power distribution circuitry
 - 2. Lighting branch circuitry
 - 3. Appliance, receptacle, and equipment branch circuitry
 - 4. Motor branch circuitry
 - 5. Control wiring
 - 6. Line voltage
- D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.02 QUALITY ASSURANCE

- A. UL Label: Conductors and connectors shall be UL labeled.

1.03 REFERENCES

- A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CONNECTORS

- A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.
- B. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
 - 1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
 - 2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-

Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.

- C. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
 - 1. All wiring inside lighting fixtures shall be temperature rated per NEC.
 - 2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.
- D. Cable Lubricant: Fire resistant, nonflammable, water based type for standard building conductors. Provide cable lubricants for fire rated cables as recommended by the cable manufacturer.

2.02 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

- A. Color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and local standards. Where such standards do not exist, color coding shall be as follows:

Color Code Table	USE CONTINUOUS COLOR CODED INSULATION THROUGHOUT					
	A	B	C	N	G	IG
120/208 3 Ph	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240 3 Ph	Black	Orange	Blue	White	Green	Green/Yellow Stripe
120/240 1 Ph	Black	N/A	Blue			
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Notes to Color Code Table:

- 1. 120/208, 120/240, and 277/480 Volt Systems shall be routed in separate raceways.
- 2. Switched legs of phase conductors for lighting and appliance branch circuits shall be of the same color as described above throughout the entire circuit.
- 3. Conductors shall be the same color from breaker to device or outlet.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.
- B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.
- C. Conductors:
 - 1. Provide a grounded (neutral) conductor for each branch circuit. Do not share

- grounded (neutral) conductors.
2. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
 3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
 4. When more than four (4) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
 5. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
 6. Before any conductor is pulled into any conduit, thoroughly swab the conduit to remove foreign material and to permit the wire to be pulled into a clean, dry conduit.
 7. Run feeders their entire length in continuous section without joints or splices.
 8. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
 9. Provide the same size wire from the panelboard to last outlet on circuit. For 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
 10. Branch circuit voltage drop shall not exceed 3% of rated voltage.
 11. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. Make taps and splices using an approved compression connector. Insulate taps and splices equal to the adjoining conductor. Make splices or taps only on conductors that are a component part of a single circuit, protected by approved methods. Taps or splices in feed through branch circuits for connection to light switches or receptacles shall be made by pigtail connection to the device.
 12. Support conductors in vertical raceways, as required by the NEC.
 13. Do not permit conductors entering or leaving a junction or pull box to deflect to create pressure on the conductor insulation.
 14. Make joints in branch circuits only where circuits divide. These shall consist of one through circuit to which the branch from the circuit shall be spliced.
 15. Make connections in conductors up to a maximum of one #6 AWG wire with two #8 AWG wires using twist-on pressure connectors of required size.
 16. Make connections in conductors or combinations of conductors larger than specified using cable fittings of type and size required for specific duty.
 17. After a splice is made, insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.
 18. Make splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
 19. All conduits shall be installed with an insulated grounding conductor per NEC 250.122. Where green conductor insulation is not available, the ground conductor shall be identified with green phasing tape at all accessible locations.
 20. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are

- more than two neutral conductors in a conduit.
- 21. Clean conductor surfaces before installing lugs and connectors.
- 22. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- 23. Provide stranded conductors connected with pressure type connectors / compression fittings and terminal lugs UL listed for the type of conductor used (AL-CU) and correctly sized to the diameter of the bare conductors.
- 24. Run mains and feeders their entire length in continuous pieces without splices or joints.
- 25. Color code conductors.
- 26. Do not install a pull string in conduits containing conductors.
- 27. Conductors shall be the same color from load side of overcurrent protection device to outlet or utilization equipment.
- 28. Spare conductors shall not be installed in any conduit, gutter, raceway, panel or enclosure unless noted otherwise.
- D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.
- E. Splices and Joints:
 - 1. In accordance with UL 486A, C, D, E, and NEC.
 - 2. Aboveground Circuits (No. 10 AWG and smaller):
 - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F, with integral insulation, approved for copper and aluminum conductors.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
- F. Aboveground Circuits (No. 8 AWG and larger):
 - 1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
 - 2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
 - 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
 - 4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.
- G. Underground Branch Circuits and Feeders:
 - 1. Submersible connectors in accordance with UL 486D, rated 600 V, 190°F, with integral insulation.

3.02 TESTING

- A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.

- B. Service Entrance and Feeder Insulation Resistance Test: Each main service entrance conductor and each feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination. Testing shall be performed by qualified technicians who have been trained in testing
- C. Submittals: Contractor shall furnish instruments and personnel required for tests. Submit 4 copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature, and weather conditions.
- D. Voltage and Current Values: The voltage and current in each conductor shall be measured and recorded after connections have been made and the conductor is under load.

END OF SECTION 26 05 19

SECTION 26 05 26
ELECTRICAL GROUNDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code.
 - 2. Governing local codes.
 - 3. All Local Utility Companies
- B. Ground effectively and permanently.
 - 1. Neutral conductor at the main service disconnect and other separately derived systems.
 - 2. All conduit systems.
 - 3. All electrical equipment and related current carrying supports or structures.
 - 4. All metal piping systems.
 - 5. All building structural metal frames.
 - 6. All telephone/voice/video/CATV/data utilities

1.02 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. Cadweld
- C. Burndy
- D. O. Z Gedney
- E. Crouse-Hinds

F. B-Line

2.02 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 1. 3/4" x 10'-0" copper clad grounding electrode.
 2. UL listed.
 3. Approved thermal fusion connector methods (exothermic).
- B. Metal frame of building or enclosure.
- C. Foundation concrete encased rebar.

2.03 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR

- A. MDF closets/head end rooms: Erico Cadweld #B544A028 ground bar with 7/16-inch holes.
- B. IDF closets, Erico Cadweld #B542A004 ground bar with 7/16-inch holes.
- C. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.

2.04 EXOTHERMIC CONNECTIONS

- A. Exothermic type for underground and structural steel; Cadweld
- B. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.05 WIRE

- A. Stranded, copper cable
- B. Foundation Electrodes: 4/0 AWG
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements

PART 3 - EXECUTION

3.01 GROUNDING AND BONDING

- A. In the service equipment, provide a separate (dedicated) ground bus.
 1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
 2. Resistance of neutral to ground shall not exceed 10 Ohms.
 3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground loop.
 4. Provide grounding and bonding at the power company's metering equipment.
 5. Provide access and cover for access to the ground grid and removable

connections for testing the system.

- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as required. Install additional rod electrodes as required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
 - 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
- C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.
- D. Provide an insulated isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and isolated grounding receptacles.
- E. Provide all conduit terminating in switchgear, transformers, switchboards, panelboards and voice/data outlets with grounding bushings, where required, and ground wire extended to ground bus in equipment. Install grounding bushings where reducing washers are used and concentric and eccentric knock-outs are used.
- F. Main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
- G. Provide bonding to meet Regulatory Requirements.
- H. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- I. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- J. Do not use spring steel clips and clamps.
- K. Do not use powder-actuated anchors.
- L. Do not drill or cut structural members.
- M. Do not use compression or mechanical connectors underground.

- N. Do not use sheetmetal or self-drilling screws for bonding connections. Provide listed or approved connectors.

3.02 METAL FRAME OF BUILDING OR STRUCTURE

- A. Effectively ground the building steel or structure per NEC 250-52 (2).

3.03 UFER GROUND

- A. Provide a UFER ground at bottom of building slab per NEC 250.52 (3), bond to building steel.

3.04 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, and other non-electrically continuous raceway fittings.
- B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Exterior Electrical Equipment Racks:
 - 1. Provide driven ground electrode.
- E. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Grounding shall conform to ANSI/TIA/EIA 607(A) – Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum. Bonding shall be of low impedance to assure electrical continuity between bonded elements.
 - 1. MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico #EGBA14424MM ground bar, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the nearest electrical switchboard or panelboard.
 - 2. IDF Closets Telecommunications Ground Bar (TGB): Provide Erico #EGBA14410FF ground bar mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel and to ground bus of nearest electrical panelboard or switchboard.
 - 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 - 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.

5. Bond each equipment rack, cabinets, frames, together and with #6 AWG insulated ground conductor to the local TMGB / TGB. Bond and ground equipment racks, housings, messenger cables, raceways, and rack-mounted conduit.
 6. Route TMGB – TGB ground conductor using the shortest, straightest, route practical with long radius curves.
 7. All conduits terminating to cable trays, wireways, and racks shall be mechanically fastened. When connected to a cable tray or rack, it must be connected with ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or IDF room grounding bar using #6 AWG copper.
- F. Ground lighting fixture bodies to the conduit grounding system.
- G. Bond receptacle ground to the box and conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.
- H. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
- I. Provide OZ Type “BJ” bonding jumper at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.
- J. Ground each lighting and power panelboard by connecting the grounding conductors to the grounding stud.
- K. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes, but is not limited to, switchboards, panelboards, disconnect switches, receptacles, cable trays, controls, fans, air handling units, pumps and flexible duct connections.
- L. Ground each light pole, power distribution poles, and metal conduit stub-ups at each light pole base.
- M. Ground all metal conduit including metal conduit used for bends and penetrations through concrete.

3.05 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.06 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.
1. Inspect and test in accordance with NETA ATS except Section 4
 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS,

Section 7.13

- B. True Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The Two-point Bonding test should be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 Ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION 26 05 26

SECTION 26 05 33
CONDUIT SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install a complete system of electrical conduits and fittings.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Raceways and Fittings unless otherwise indicated:
1. Allied
 2. International Metal Hose
 3. Ipex
 4. Heritage Plastics
 5. Wheatland
 6. Can-Tex
 7. North American Pipe
 8. Anamet, Inc.
 9. Electri-Flex Co.
 10. Western Tube and Conduit
- B. Stainless Steel Conduit and Fittings:
1. Calbrite
 2. Gibson
- C. Aluminum Conduit and Fittings:
1. American Conduit/Sapa
 2. Wheatland
 3. Patriot Aluminum Products
- D. Condulets and Conduit Bodies unless otherwise indicated:
1. Appleton
 2. Form 85
- E. Stainless Steel Condulets and Conduit Bodies:
1. Calbrite
 2. Gibson
 3. Crouse Hinds
- F. MC Cable (light fixture whips only)
1. AFC
 2. Southwire
 3. General Cable
 4. Kaf-Tech

2.02 PROHIBITED PRODUCTS

- A. Prohibited Products
 - 1. BX cable
 - 2. AC cable
 - 3. Electrical nonmetallic tubing (ENT)
 - 4. Flexible polyethylene or PVC tubing
 - 5. Intermediate Metal Conduit (IMC)

2.03 RIGID METAL CONDUIT (RMC)

- A. Schedule 40 conduit and fittings:
 - 1. Galvanized Conduit - Mild steel pipe, Zinc coated inside and out
 - 2. Aluminum Conduit - Aluminum Alloy 6063, T-1 temper
 - 3. Threaded ends and fittings
 - 4. Insulated bushings

2.04 ELECTRICAL METALLIC TUBING (EMT)

- A. Metallic Tubing
 - 1. Zinc Coated Steel - Cold rolled steel tubing, Zinc coated inside and out
 - 2. Aluminum - Aluminum Alloy 6005, 6063. Temper T-1
- B. Fittings shall meet the same requirements as EMT conduits.
 - 1. Full Compression Fittings
 - 2. Insulated throat connectors
- C. Prohibited Products
 - 1. Cast metal fittings
 - 2. Uni-couple type connectors
 - 3. Split ring, anti-short bushings

2.05 FLEXIBLE CONDUIT

- A. Steel flexible metallic conduit:
 - 1. Zinc coated inside and out
 - 2. 18-inches minimum length, 24-inches maximum length
 - 3. 18 inches minimum length; 6 feet maximum length for light fixture whips only
- B. Liquid tight flexible steel conduit
 - 1. Type L.A. - Grounded
 - 2. 18-inches minimum length, 24-inches maximum length

2.06 PVC CONDUIT

- A. Schedule 40 and Schedule 80
- B. PVC fittings and solvent welded joints
- C. PVC elbows and fittings, except for threaded/slip-on/glue or straight conduit slip-on / glue fittings, shall not be used on this project.

2.07 CONDULETS AND CONDUIT BODIES

- A. Form 85
- B. PVC Coated: Form 8
- C. LBC Condulets shall be used for size 2 inch and above. LL and LR Condulets shall not be used for 2 inch and above

2.08 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

- A. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.
- B. Acceptable Manufacturer:
 - 1. Portable Pipe Hangers
 - 2. Cooper B-Line C-Port
 - 3. Miro Industries Models 2.5, 2.5-5, 2.5-AH, 12-AH, 16-AH

2.09 STAINLESS STEEL CONDUIT

- A. Rigid Conduit, Fittings and Supports:
 - 1. Type 304 Stainless Steel
 - 2. Threaded ends
 - 3. Insulated Bushings
- B. EMT, fittings and Supports:
 - 1. Type 304 Stainless Steel
 - 2. Compression Fittings
 - 3. Insulated Bushings

2.10 METAL CLAD (MC) CABLE

- A. Minimum conductor size shall be #12 AWG. All conductors sized #8 and larger shall be stranded copper.
- B. All MC Cable shall have an insulated ground conductor.
- C. Armor: An aluminum or zinc coated galvanized steel armor shall be applied over the cabled wire assembly with an interlock in compliance with Section 13 of UL 1569.
- D. Fittings shall be UL listed and identified as MCI-A for such use with metal clad interlocking armor ground. Connectors shall be of steel or malleable iron and shall have saddle clamp to insure a tight termination of MC or MCI-A Cable to box.

2.11 EXTERIOR IN-GRADE PULL BOXES

- A. Hubbell CDR 30x48 inch minimum, provide larger size as required by conduit size or quantity:
 - 1. Tier 22 rated traffic duty
 - 2. Conduit entry knock-outs as required

3. Bolt down cover
4. Integral or separate bottom
5. Adjust to grade option
6. Extension as required for specified conduit depth

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install electrical conduits and fittings for all wiring of any type unless otherwise indicated.
- B. Minimum Size Conduit:
 1. 0.5-inch unless otherwise indicated
 2. (2) 1-inch for low voltage systems unless otherwise indicated
 3. 2-inch between buildings unless otherwise indicated
- C. Provide separate raceway systems for each of the following when specified, indicated or required:
 1. 120/208 volt circuits
 2. Voice/Data
 3. Security CCTV
 4. Security System
 5. Communications / PA Systems / Sound System Line Input and Speakers
 6. Fire Alarm
 7. Lighting and Building Management Control Systems
- D. Maintain 13-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- E. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- F. Use conduit hubs to fasten conduit to sides and tops of electrical equipment, device, box, gutter, wireway, disconnect, etc. in damp and wet locations.
- G. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- H. Do not use no-thread couplings and connectors for galvanized steel or aluminum rigid conduit.
- I. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.
- J. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
 1. Insulated throat connectors for EMT conduits.
 2. Insulated bushing on all rigid conduit terminations.
 3. Locknuts inside and outside of all boxes and enclosures.
 4. Threaded type plastic bushing at all boxes and enclosures.
- K. All boxes are to be accessible after completion of construction.

- L. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pours.
- M. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-feet maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.
- N. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.
- O. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting.
- P. Make up threaded joints of conduit carefully in a manner to ensure a tight joint.
- Q. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing.
- R. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas.
- S. Install one 2-inch diameter conduit nipple between multi-sectional panels independent of feeder conductors.
- T. Prohibited Installations unless noted otherwise
- U. Do not route on floors, paved areas or grade.
- V. Do not Obstruct Equipment Manufacturer's Recommended Service Space or access to that location
- W. Where aluminum alloy conductors are specified, approved and substituted for copper conductors, provide the required conduit size based on conduit fill using NEC or recognized cable manufacturer's conduit fill tables for aluminum alloy compact conductors.

3.02 INTERIOR ABOVE GRADE INSTALLATION

- A. Conduit Types
 - 1. Concealed Locations:
 - a. EMT
 - 2. Exposed conduits in Equipment Rooms:
 - a. EMT
 - b. RGC when installed below 18-inches above finished floor.
 - 3. Exposed conduits:
 - a. RGC:
 - 1.) Below 9-feet AFF
 - b. Aluminum rigid conduit
 - 4. Wet Location
 - a. Aluminum rigid conduit
 - 5. Damp Location
 - a. Aluminum rigid conduit
 - 6. Conduit in concrete walls, floor or roof slab:
 - a. RGC
 - 7. Conduit elbows and rises through the slab or foundation
 - a. RGC

- B. Maintain head room and present neat appearance.
- C. Minimum 6-inches clear of bottom of roof deck.
- D. Perpendicular or parallel to building lines.
- E. Where a piece of equipment is connected from a switch or box on adjacent wall, the conduit shall go up the wall from the box, across, and back down to the equipment.
- F. Conceal conduit systems in finished areas.
- G. Conduit may be exposed in exposed mechanical and electrical rooms or where otherwise indicated.
- H. Prohibited Installations
 - 1. Do not block walkways

3.03 LIGHT FIXTURE WHIPS

- A. Flexible conduit or MC cable used for lighting fixture connection shall be supported from the structure with #13 AWG galvanized iron wire pendants and "Caddy clips".
- B. Each light fixture shall have its own fixture whip from junction box.
- C. Light Fixtures installed end to end or recessed in non-accessible ceilings may connected use chase nipples.
- D. Prohibited installation:
 - 1. Do not install "Daisy Chain" light fixtures installed above accessible ceilings.

3.04 BELOW GRADE INSTALLATION

- A. Conduit Type:
 - 1. PVC
 - 2. Rigid Galvanized Conduit (RGC) for transitional bends and rises from underground PVC conduit up to 18" above grade when passing through a slab or foundation, or when subject to physical damage
- B. Unless shown otherwise, do not install conduit in or below concrete building slabs.
- C. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.
- D. Changes in direction of underground conduit runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet and a maximum arc of 22.5 degrees.
- E. Provide conduit spacers for parallel branch/feeder conduits. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement during concrete placement.
- F. Conduit below building slab shall be installed minimum 18-inches below finished floor and in select fill.
- G. Electrical feeder conduits, telecommunications tie, trunk, or service cable conduits shall

be installed minimum 48-inches below finished floor and in select fill.

- H. Electrical service primary shall comply with the respective utility company requirements and standards.
- I. Provide two “caution” plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement.
- J. Conduits located outside building, provide magnetic locator tape at top of first compacted layer of backfill.
- K. As each section of the underground conduit is completed, a testing mandrel with diameter $\frac{1}{4}$ -inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
- L. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways.
- M. Conduit for 120V and above shall be separated from control and signal conduits by a minimum of 3-inches.
- N. Prohibited Installation.
 - 1. Unless shown otherwise, do not install conduit horizontally in concrete slabs.

3.05 EXTERIOR ABOVE GRADE INSTALLATION

- A. Conduit Type:
 - 1. Aluminum Rigid Conduit
 - 2. RGC where subject to physical damage or where located less than four feet above finished floor, grade or pavement.
- B. Conduit for mechanical / plumbing equipment shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.

3.06 ABOVE ROOF INSTALLATION AND ROOF PENETRATION

- A. Where specifically indicated to be routed or mounted on the roof, installation shall be as specified, recommended by roofing manufacturer, recommended by roof support manufacturer and as required by NEC.
- B. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing.
- C. Conduit for equipment mounted on roof curbs shall be routed through the roof curb.
- D. Prohibited Installations:

1. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise.
2. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.

3.07 CONDUIT SUPPORTS

- A. Fasten conduit supports to building structure and surfaces;
- B. Support with malleable iron conduit clamps or on conduit racks at intervals as required by NEC
- C. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Channel supports shall have cut ends filed smooth
- D. Where rod pendants are not used, channel supports are to be secured to structure at each end.
- E. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt “wings” are not acceptable.
- F. Support single conduit runs using a properly sized galvanized conduit hanger.
- G. Group related conduit on conduit rack. Construct rack using steel channel; provide space on each rack for 25 percent additional conduits.
- H. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.
- I. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks. Coordinate routing with Architect / Owner.
- J. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners.
- K. Galvanized Surfaces: Clean welds, bolted connections, cuts, and abraded areas and apply ZRC galvanized paint or equivalent.
- L. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with “Tee” conduit at motor outlet height for flexible conduit.
- M. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers.
- N. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.
- O. Anchors:
 1. Rawl Plugs or approved equal anchors.
 2. Lead cinch anchors or pressed anchors.
- P. Hardware:

1. Indoors: cadmium plated unless noted otherwise
2. Exterior: Galvanized unless noted otherwise

Q. Prohibited Installation.

1. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
2. Do not support conduit from conduit, ceiling support wires, roof deck, structural bridging
3. Plastic anchors and lead anchors shall not be used for overhead applications.
4. Beam clamp attachments to steel joist chords
5. Do not support more than one conduit from a single all-thread rod support.
6. Do not utilize Tie wire or short pieces of conduit as supports or hangers.

R. Acceptable Manufacturer's

1. Kindorf,
2. Unistrut,
3. Superstrut,
4. Caddy,
5. Minerallac

3.08 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

- A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, grade level other than floor, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
 2. Sleeves shall extend 3-inches above the finished floor.
- B. Sleeves in concrete or masonry walls shall be Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.
- C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.
- D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to serve as a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.
- E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with 1/4-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.
- F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof

openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.

- G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.09 PVC CONDUIT AND FITTINGS INSTALLATION

- A. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.

3.10 FLEXIBLE METAL AND LIQUID TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS INSTALLATION

- A. Liquid Tight Flexible Metal Conduit shall only be used for connections to equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.
- B. Liquid tight flexible metal conduit may be 0.5-inch for roof top supply / exhaust fans only
- C. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to equipment, light fixtures, power poles, etc.
- D. Prohibited Installation:
 - 1. Do not use for exterior wall or roof penetrations unless sleeved utilizing PVC coated RGC conduit at least one size larger than the outside diameter of the flexible conduit.

3.11 EXTERIOR IN-GRADE PULL BOXES

- A. Provide pull boxes where specified and as required.
- B. Pull boxes located in pavement shall be set with proper extensions so that top of cover is flush with pavement.
- C. Pull boxes located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3.12 IDENTIFICATION

- A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V) or signal / communication conduit. Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION 26 05 33

SECTION 26 05 35
ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Electrical connections as required and scheduled, and as specified.

1.02 RELATED WORK

- A. Refer to other Divisions for specific individual equipment electrical requirements.

1.03 QUALITY ASSURANCE

- A. UL Label: Products shall be UL listed to the extent possible.

PART 2 - PRODUCTS

2.01 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.
- B. Raceways: Refer to related sections.
- C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.
- D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.
- D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.

- E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.
- F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.
- G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, food service / processing equipment, electronics, control panels and Owner furnished equipment:
 - 1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
 - 2. Where conduit originates from an elevation above the conduit entry, provide a "T" conduit below the enclosure's bottom elevation. Provide conduit from the conduit up to the enclosure bottom horizontal surface for electrical connection.
- H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.
- I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.

END OF SECTION 26 05 35

SECTION 26 05 37
ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.02 QUALITY ASSURANCE

- A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS

2.01 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
 - 1. Type of Various Locations:
 - a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
 - b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
 - c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
 - d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
 - e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
 - f. Surface: Type FS or FD box with surface cover.
 - g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
 - h. Hazardous (Classified) Locations: Explosion proof boxes, seals and fittings.
 - i. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
 - 2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.

- B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.
- C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.
- D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
 - 1. Type for Various Locations:
 - a. Minimum Size: 4-inch square, 2-1/8-inches deep.
 - b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
 - c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners
- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.
- F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.
- G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 - EXECUTION

3.01 INSTALLATION OF BOXES AND FITTINGS

- A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.
- B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.
- C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated

differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.

- D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.
- E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.
- F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.
- G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.
- H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.
- I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.
- J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- K. Provide knockout closures to cap unused knockout holes in boxes.
- L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.
- M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.
- N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.

- O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.
- P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.
- Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.
- R. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example "MSB to Panel HA"). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example "LA2" referring to Panel LA sec. 2 is to be listed as "LA"). Label covers for special applications explaining contents (example "Emerg. Gen. Annunciator controls", "IDF ground"). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example "Not Used Panel LA". Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.
- S. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- T. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.
- U. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- V. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.
- W. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.
- X. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- Y. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.
- Z. Use adjustable steel channel fasteners for hung ceiling outlet box.
- AA. Do not fasten boxes to ceiling support wires.
- BB. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.
- CC. Use gang box where more than one device is mounted together. Do not use sectional box.

- DD. Use gang box with plaster ring for single device outlets.
- EE. Support outlets flush with suspended ceilings to the building structure.
- FF. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.
- GG. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.
 - 1. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.
- HH. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.
- II. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.
- JJ. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.
- KK. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.
- LL. Bond equipment grounding conductor to all junction and pull boxes.
- MM. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.
- NN. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.
- OO. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.02 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

END OF SECTION 26 05 37

SECTION 26 24 16
PANELBOARDS AND ENCLOSURES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.02 QUALITY ASSURANCE

- A. UL Standards: Panelboards and enclosures shall confirm to all applicable UL standards and shall be UL labeled.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. General Electric Co.
- C. Siemens
- D. Eaton

2.02 MATERIALS AND COMPONENTS

- A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and as required.
- B. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Neutral bus termination quantity for branch circuit panelboards shall match or exceed the maximum number of single pole circuit breakers the panelboard will accept.
- C. Main circuit breakers and feeder / branch circuit breakers:
 - 1. Less than 125 Amps: Thermal magnetic with factory fixed trip.
 - 2. 125-600 Amps: Thermal magnetic with adjustable instantaneous trip of 5X – 10X with short time tracking.
 - 3. 601 Amps and larger: Solid state true RMS sensing with adjustable: current set by rating plug or adjustable dial, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - 4. Provide permanent lock-off device where indicated or required for circuit breaker to be used as a remote safety disconnect switch.
 - 5. General requirements:
 - a. Make prepared space provisions for additional breakers or fused switches

- so that no additional bus or connectors will be required to add circuit breakers or fused switches in the available device mounting space.
 - b. Two and three pole breakers shall have internal common trips.
 - c. All circuit breakers used as the main or branch mounted back-fed main shall be bolt-on. All circuit breakers used in 600 Amp and smaller panelboards shall be bolt-on breakers. Circuit breakers for distribution panelboards rated 601 amps and larger shall have plug-on or bolt-on circuit breakers.
 - d. Branch circuit panelboard shall have interrupting capacity as shown or as required, but in no case less 10k AIC for 120/208/240-Volt systems, and 18k AIC for 277/480-Volt systems.
 - e. 15 and 20 Amp circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
 - f. Personnel ground fault interrupter (GFI) circuit breakers, where shown, shall be maximum 5 mA ground fault trip and shall include a TEST button.
 - g. Equipment ground fault interrupter (EGFI/EGPD) circuit breakers, where shown or required shall be 30mA ground fault trip and shall include TEST button.
 - h. Circuit breakers with 1,200 Amp and larger frame shall have Energy Reducing Maintenance Switching with local status indicator (ERMS).
- D. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.
- E. Integrated Equipment Rating: Do not apply series ratings. Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.
- F. Panelboard Enclosures:
- 1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner's standard key system; coordinate with Owner.
 - 2. All NEMA 1 enclosure panelboards shall be hinged "door-in-door" type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right. Manufacturer hardware (OEM), screws, and bolts shall be used to secure dead fronts and covers. Do not use third party hardware. Do not use power tools to secure panel hardware. Provide gray powder coat finish over a rust inhibitor.
 - 3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
 - 4. Panelboards located in kitchen preparation or natatorium areas shall have Type

316 stainless steel front, door, and trim with a NEMA 1 rating for the entire enclosure.

5. Panelboards at exterior locations shall be NEMA 4X Type 316 stainless steel.
6. Enclosure shall be for recessed or surface mounting as shown or as required.
7. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

PART 3 - EXECUTION

3.01 INSTALLATION OF PANELBOARDS AND ENCLOSURES

- A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.
- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.
- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).
- E. Fuses: Install fuses, of the ratings and class shown.
- F. Circuit Arrangement: Branch circuits shall be arranged to provide the best possible phase balance, unless shown otherwise.
- G. Panelboards not intended to be used as service entrance (SE) rated or for establishing a separately derived neutral system shall have the factory installed neutral to ground bonding screws and straps removed and disposed of.
- H. Recessed or flush mounted panelboards: Terminate spare conduits in junction box 18-inches above accessible ceiling close to panelboard location. Label junction box cover as "not used" and include panel identification.
 1. Provide (3) 1-inch and (3) ¾-inch spare conduits above accessible ceiling to j-box from each panelboard section.
 2. Where recessed panelboard is located above another building floor, also provide (3) 1-inch and (3) ¾-inch conduits to j-box in ceiling space on floor below.
- I. Conductors shall be bent neatly opposite the fuse switch or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top

or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.

- J. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to panelboard enclosure with mechanical lugs and not to ground bus.
- K. Install panels so that breaker number 1 is the top left breaker.
- L. In panels that contain multi-layered neutral bus, install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- M. Label breaker mounting space with stick-on number labels.
- N. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78-inches. Mount panelboards as high as practical and such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.02 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.

END OF SECTION 26 24 16

SECTION 26 24 25
ENCLOSED SWITCHES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Safety and disconnect switch work where required, scheduled, indicated, specified, and required. For switches indicated or rated above 1,200 Amps, provide switchboard construction as specified for switchboards.
- B. UL Approved: Safety and disconnect switches shall have UL approval and the UL label.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. General Electric Co.
- C. Siemens
- D. Eaton

2.02 ENCLOSED SWITCHES

- A. General: Provide heavy duty type, dead-front, sheet steel enclosed, surface-mounted safety switches of the type and size indicated. Safety switches shall be rated for the voltage of the circuit where they are installed. Safety switches used as motor disconnects shall be rated for the motor horse power served.
- B. Switch Mechanism:
 - 1. Safety switches shall be quick-make, quick-break type with permanently attached arc suppressor. Constructed so that switch blades are visible in the OFF position with the door open. The operating handle shall be an integral part of the box, not the cover. Switch shall have provision to padlock in the OFF position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the ON position, or closing of the switch mechanism when the switch door is open.
 - 2. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. Current-carrying parts shall be constructed of high conductivity copper with silver-plated switch contacts. Lugs shall be suitable for copper conductors and front removable.
- C. Neutral: Provide safety switches with number of switched poles indicated. Where a neutral is present in the circuit, provide a solid neutral with the safety switch. Where a ground conductor is present in the circuit, provide a separate solid ground with the safety switch.

2.03 ENCLOSED SWITCHES WITH OVERCURRENT AND/OR GROUND FAULT

PROTECTION

- A. Overcurrent protective devices 1,200 Amps and below:
 - 1. Where switch is intended as a building service disconnect provide solid neutral and ground bus and service entrance SE rating.
 - 2. Molded case circuit breakers:
 - a. 800 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - 3. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

2.04 ENCLOSURES

- A. Enclosures in indoor locations shall be NEMA 1 unless shown otherwise.
- B. Enclosures in exterior locations shall be NEMA 4X stainless steel.
- C. Enclosures at kitchen and food preparation locations, exterior kitchen supply and exhaust fans, hose down areas, cooling towers, in greenhouses, and in other corrosive areas shall be NEMA 4X, stainless steel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install safety and disconnect switches where required or indicated, in accordance with the manufacturer's written instructions, requirements of the NEC, NECA Standard of Installation, and industry practices. Provide fuse identification label when fused switches are required showing type and size inside door of each switch. Include devices in coordination study to indicate overcurrent devices will selectively coordinate.
- B. Location: Provide safety switches within 50' and in sight of motor served. There shall be minimum code required clearance in front of safety switch and a clear path in which to access the switch. (i.e.: not having to walk and/or stand on obstacles such as drain pans on floor to service).
- C. Supports: Provide all safety and disconnect switches with galvanized angle or other supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on

equipment served, the switch shall not inhibit removal of service panels or interfere with access areas, not void the warranty of the equipment served. Provide mounting hardware that will allow removal of safety and disconnect switches with common work tools. Do not utilize drive pin anchors through enclosure.

- D. Safety and Disconnect Switches: Install disconnect switches for motor-driven equipment, appliances, motors, and motor controllers within sight of the controller position unless indicated otherwise.
- E. Variable Frequency Drive (VFD) Warning Plaque: Provide VFD warning plaque at safety disconnect switches which are located down-stream of VFDs. Secure plaque to disconnect switch or immediately adjacent to disconnect switch with fasteners. Plaque shall be Yellow-White-Yellow 3-layer plastic laminated engraved with: "WARNING" (1/2 Inch Letters). "TURN OFF VFD BEFORE OPENING THIS SWITCH FOR MAINTENANCE." (1/4 inch letters).
- F. Where disconnect switch is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building's grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the disconnect switch.

3.02 TESTING

- A. General: Before energizing, check for continuity of circuits and short circuits.

END OF SECTION 26 24 25

SECTION 27 26 73
WIRING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide wiring device work as shown, scheduled, indicated, and specified.

1.02 QUALITY ASSURANCE

- A. UL Label: Wiring devices shall be UL labeled.
- B. NEMA Standard WD1 and WD6
- C. Fed. Spec. WC596, W-S-896

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Leviton, Mfg. Co., Inc.
- B. Pass and Seymour, Inc.
- C. Hubbell, Inc.
- D. Cooper – Arrow Hart
- E. Lutron, Inc. (Dimming)

2.02 WIRING DEVICE COLOR

- A. Device color shall be white except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source shall be red. Verify with Architect prior to submitting for approval.

2.03 RECEPTACLES

- A. Commercial grade receptacles, NEMA configuration indicated.
 - 1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #16352 or equal
 - 2. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R: Leviton #7898 or equal
 - 3. Provide weather resistant (WR) receptacles at all exterior locations

2.04 WALL SWITCHES

- A. Toggle: Commercial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.

2.05 INTERIOR WALL COVER PLATES

- A. Smooth finish, molded of high impact nylon.
 - 1. Plate color shall match device and/or toggle color.
 - 2. Fastening screws shall match plate color.

2.06 EXTERIOR RECEPTACLE COVER PLATES

- A. Thomas & Betts CKSUV, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All wiring devices for receptacles and wall switches shall be of the same manufacturer throughout unless otherwise noted.
- B. Install wiring devices where shown, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install receptacles and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.
- D. Install wiring devices plumb and aligned in the plane of the wall, floor, or ceiling in where they are installed.
- E. Install switches in boxes on the strike side of doors as hung. Verify door swing ogf all doors prior to rough-in. Install a uniform position so the same direction will open and close the circuit throughout the project. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
- F. Provide a plate for every receptacle, switch, telephone outlet and other wiring devices
- G. Mounting heights of all wiring devices shall comply with current Accessibility Standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.
- H. Refer to Architectural drawing, elevations, etc. for exact location of wiring devices where indicated on the Architectural plans. Coordinate location of all wiring devices with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction.
- I. Locate receptacles for electric drinking fountains so that the receptacle is accessible and concealed as much as practical from public view.
- J. Provide weatherproof and weather resistant (WR) GFCI, 20A, 125V duplex receptacles outdoors where indicated and within 25' of all new electrically operated equipment mounted outdoors and on roofs.

- K. Provide GFCI, 20A, 125V duplex receptacles at all receptacle locations in custodial rooms, electric drinking fountains, vending machines, kitchen and food preparation areas, and all locations where receptacles indicated are within six feet of water sources, sinks, lavatories, faucets, and mop sinks. Where outlet is indicated behind vending machines or drinking fountain cowlings, or other equipment, provide remote GFCI blank face in readily accessible location with standard receptacle outlet behind equipment.
- L. Install wall box dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- M. Do not share neutral conductor on dimming circuits.
- N. Install receptacles with grounding pole down, or as directed by Owner. If installed horizontally, install with neutral on top.
- O. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- P. Connect wiring devices by wrapping ground conductor around screw terminal or inserting into mechanical lug. Provide pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap neutral and phase conductors around screw terminals. Tighten all screws and lugs as recommended by manufacturer.
- Q. Provide nameplate engraving for emergency outlets at locations indicating panelboard and circuit number.

3.02 TESTING

- A. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization. Test GFCI receptacle operation with simulated ground fault tester.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

END OF SECTION 26 27 73

SECTION 26 51 13
LIGHTING FIXTURES AND LAMPS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Work Included: Lighting fixture work is as shown, scheduled and specified.
- B. Applications: The applications of lighting fixtures required for the project include the following:
 - 1. General lighting
 - 2. Emergency lighting
 - 3. Outdoor area lighting

1.02 QUALITY ASSURANCE

- A. Provide interior building LED fixtures that comply with the Design Lights Consortium (DLC) standards and are DLC listed as a Qualifying Product at time of proposal submittal date.
- B. UL Standards: Lighting fixtures shall conform to applicable UL standards, and be UL or ETL labeled.
- C. Light fixtures shall conform to the requirements of NFPA 101, and 70 (NEC).

1.03 SUBMITTALS

- A. Submit product data for light fixtures, and emergency lighting equipment, including generator transfer devices.
- B. 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.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by manufacturers shown or scheduled for each type of lighting fixture. Refer to drawings for approved light fixture manufacturers.
 - 1. Emergency Battery Packs:
 - Bodine
 - IOTA
 - Chloride
 - Lithonia
 - Dual Lite

2.02 MATERIALS AND COMPONENTS

- A. General: Provide lighting fixtures of the size, type, and rating indicated, complete with, but not limited to, lamps, lamp holders, reflectors, ballasts, starters, and wiring.
- B. Fixture Types:
 - 1. General:
 - a. Lay-in troffer fixture panel type lenses, where specified, shall be extruded virgin acrylic, prismatic type minimum 0.125" thick, 7.8-ounces per square foot minimum.
 - b. Fixtures in continuous rows shall be supplied with fixture couplings, chase nipples, and accessories recommended by the manufacturer for continuous row installation.
 - c. Safety chains and wire guards at fixtures in mechanical and electrical rooms, gymnasiums and high abuse areas.
 - d. Fixtures located outdoors, in interior unconditioned spaces, and in wet locations shall be of aluminum construction.
 - e. Fixture door frame shall be of aluminum construction, white finish where located in kitchens, food prep areas, toilets, restrooms, locker rooms, dressing rooms, showers, and unconditioned spaces.
 - f. DLC or Energy Star qualified unless specified otherwise.
 - g. Minimum 5-year replacement warranty for driver and light engine.
 - h. Outdoor fixtures shall include a discrete / replaceable surge suppression device in addition to the surge suppression incorporated in the LED driver.
 - i. Operating temperature rating shall be between -40 degrees F and 120 degrees F.
 - j. Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor
 - k. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).
 - 2. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed. Downlight fixtures shall have a minimum efficiency of 65-percent and exhibit "lamp before lamp image" 45-degree cutoff for ceiling up to 10 feet.
 - 3. LED Exit Signs: The exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes.
 - a. Gymnasiums, locker rooms, athletic/PE wing and associated corridors, black box theaters, auditorium stages, cafeteriums and kitchens: Vandal resistant, wet location cast aluminum with polycarbonate protective cover exit signs, Lithonia Extreme Series.
 - 4. Emergency Lighting Units: Lead Calcium batteries with self-diagnostics. Provide full light output at 90 minutes of battery operation. LED lamps.
- C. LED drivers:
 - 1. NEMA 410 compliant for in-rush current.

2. Drivers shall have a minimum efficiency of 85%.
 3. Starting Temperature: -40° F [-40° C].
 4. Input Voltage: 120 to 480 ($\pm 10\%$) V.
 5. Power Supplies: Class I or II output.
 6. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 7. Power Factor (PF): ≥ 0.90 .
 8. Total Harmonic Distortion (THD): $\leq 20\%$.
 9. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 10. Drivers shall be reduction of hazardous substances (ROHS)-compliant.
- D. Voltage: Equipment for use on 120V systems shall be suitable and guaranteed for voltage range of 100V to 130V. Equipment on 277V systems shall be suitable and guaranteed for voltage range of 225V to 290V. Universal voltage equipment shall be suitable and guaranteed for a voltage range of 100V to 290V.
- E. Light fixture housing for exterior use: Provide aluminum or stainless housing. Where stainless steel hardware is used, both male and female fasteners shall be stainless steel.
- F. Emergency LED battery self testing drivers and inverters; 5 year warranty.
1. Bodine BSL-ST Series for OEM installation
 2. Bodine BSL310-SI Series for field installation
 3. Bodine ELI-S Series for line voltage sine wave inverter field installation
- G. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install lighting fixtures of the types indicated, where shown, and at indicated heights in accordance with the fixture manufacturer's written instructions and industry practices to ensure that the fixtures meet the specifications. Fixtures shall fit the type of ceiling system scheduled.
- B. Standards: Comply with NEMA standards, applicable requirements of NEC pertaining to installation of interior lighting fixtures, and with NECA Standard of Installation.
- C. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide four separate wire supports for recessed ceiling mounted lighting fixtures, one at each corner of fixture. Check to ensure that solid pendant fixtures are plumb. Provide T-bar locking clips on all four sides for lay-in fixtures.
- D. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance. Relocate installed light fixtures as directed by Owner / Architect at no additional cost.

- E. Final adjustment of all aimable exterior light fixtures shall be in coordination with, and to the satisfaction of, the Owner's designated representative. Pre-aim all fixtures prior to scheduled final aiming and adjustment with Architect / Owner. Verify that all rotatable optics are in their proper orientation prior to final aiming.
- F. Provide vandal resistant exit signs without wire guards in all physical education and athletic sports areas, including egress corridors adjacent to these areas, black box theaters, auditorium stages, vocational shops, cafeteriums and kitchens.
- G. Provide exit sign directional arrows as required. Provide a minimum of two and a maximum of 10% spare exit signs to be installed as directed by Architect.
- H. Install in accordance with manufacturers instructions.
- I. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.
- J. Locate recessed ceiling luminaries as indicated on the Architectural reflected ceiling plan.
- K. Install surface mounted luminaries plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- L. Exposed Grid Ceilings: Support surface mounted luminaries on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling Ts to support surface mounted luminaries. Fasten surface mounted luminaries to ceiling T using bolts, screws, rivets, or suitable clips.
- M. Install recessed luminaries to permit removal from below.
- N. Install recessed luminaries using accessories and fire stopping materials to meet regulatory requirements for fire rating.
- O. Install wall-mounted luminaries at height as directed by Architect.
- P. Install accessories furnished with each luminary.
- Q. Connect luminaries to branch circuit outlets using flexible conduit as specified.
- R. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaries.
- S. Bond products and metal accessories to branch circuit equipment grounding conductor.
- T. Provide emergency transfer devices for light fixtures powered by generator or inverter emergency lighting circuits which are used for normal lighting and to be switched with the switched normal lighting circuit in the same room, corridor or area.
- U. Provide un-switched, constant-hot circuit to all battery powered emergency lighting equipment and emergency transfer devices (GTD). Where normal light fixture circuit is switched or contactor controlled, non-switched battery charging or GTD circuit shall

originate from same branch circuit breaker as switched lighting circuit.

- V. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, switchboards, motor control centers, low voltage control panels, transfer switches, motor controllers and disconnect switches.
- W. Provide emergency battery operated light fixtures at all transfer switch locations and at all central battery emergency lighting inverters.
- X. Provide automatic controls for exterior light fixtures. Exterior building mounted light fixtures shall be circuited through lighting contactors. Lighting contactors shall be controlled by the Building Management System. Where no building management system is provided or specified, provide time clock switches, photocells, photosensors as specified, and required by the local energy codes.
- Y. Lighting contactors shall not be installed above ceiling and shall be readily accessible, located in same room as panelboard serving load.
- Z. Wall mounted light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable. Where wall mounted fixtures attach to junction box only, firmly secure junction box to adjoining studs in wall.
- AA. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
- BB. Hardware for surface mounting fixtures to suspended ceilings:
 - 1. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 - 2. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 1/4 inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4 inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.

3.02 TESTING

- A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and

proceed with retesting.

- B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.
- C. Final aiming and Adjustment: Aim and adjust aimable and adjustable lighting fixtures for their intended purpose. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

END OF SECTION 26 51 13

SECTION 28 31 02
EXPANSION OF EXISTING FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide all detailed engineering, documentation, materials and devices, installation, calibration, software programming and check-out necessary for a complete and fully operational fire detection and alarm system in accordance with the full intent and meaning of the drawings and specifications including, but not limited to, the following:
 - 1. Supply, install and connect all hardware necessary to provide a complete and operational fire detection and alarm system.
 - 2. Supply, install and wire all field hardware, power supplies, power circuits, alarm initiating devices, audible and visual alarm devices, auxiliary control relays, signal initiating and signaling devices, conduits, wires, fittings and all accessories required for the system to perform as specified as required. Use and expand the existing fire alarm control panel.
 - 3. Supply, install, debug and test all software required to provide all software functions described in accordance with the full intent and meaning of the drawings and specifications.
 - 4. Coordinate the work specified under this Section with other trades and contractors to assure a complete and fully operational system.
- B. The intent of fire detection and alarm system work is specified in this section and indicated on the drawings. The installing contractor shall design and provide a complete system, meeting the requirement of this section. The Contractor shall provide all fire alarm and initiation devices in new and renovated areas required for a complete system acceptable to all governing authorities. Provide proper spacing and coverage of all devices.

1.02 RELATED SECTIONS

- A. Divisions 22 & 23
- B. Fire Suppression Systems
- C. Food Service

1.03 CODES / STANDARDS / REFERENCES (LATEST EDITIONS)

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 13 Systems, Installation
 - 2. NFPA 17 Dry Chemical Extinguishing Systems
 - 3. NFPA 70 National Electrical Code
 - 4. NFPA 72 National Fire Alarm Code.
 - 5. NFPA 80 Fire Doors and Fire Windows
 - 6. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 7. NFPA 92A Smoke Control Systems

8. NFPA 101 Life Safety code.
 9. NFPA 105 Smoke Control Door Assemblies
 10. NFPA 2001 Fire Extinguishing Systems, Clean Agent
- B. UL: Underwriters Laboratories, Inc.
1. 217 Single and Multiple Station Smoke Detectors.
 2. 268 Smoke Detectors for Fire Protective Signaling Services.
 3. 864 Control Units for Fire Protective Signaling Services.
 4. 864 Transient protection
 5. 1480 Speakers for Fire Protective Signaling Systems
 6. UL Fire Protection Equipment Directory.
 7. UL Electrical Construction Materials Directory.
- C. Factory Mutual P7825 Approval Guide
- D. American National Standards Institute (ANSI).
- E. National Electrical Manufacturer's Association (NEMA).
- F. Institute of Electrical and Electronic Engineers (IEEE).
- G. Electronic Industries Association (EIA-232-C): Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
- H. Requirements of American Disabilities Act (Public Law 101-336).
- I. Local Accessibility Standards, Codes, and Ordinances
- J. State Fire Marshall or Requirements of Local Authorities having Jurisdiction
- K. State Insurance Code.
- L. National Building Code.
- M. International Building Code.
- N. Uniform Building Code.
- O. Local & State Building Codes.
- P. In addition the above requirements, comply with all local codes. Where discrepancies exist between codes, drawings or specifications, the more stringent requirement shall prevail. Installation shall be subject to approval, inspection and test of applicable regulatory agencies.

1.04 MANUFACTURER'S, PLANNER'S AND INSTALLER'S QUALIFICATIONS

- A. The manufacturer shall regularly and presently produce, as the manufacturer's principle products, the equipment and material of the type and design specified for this project, and

shall have manufactured the item for at least 5 years. All components of the system shall be UL compatible with the existing main fire alarm control panel. Manufacturer of all components shall match existing manufacturers of similar or same type components unless otherwise specified or noted on the drawings.

- B. 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.
- C. The entire Fire Detection and Alarm System shall be installed by a factory authorized representative of the existing main fire alarm control panel and certified by the manufacturer to distribute, sell, and install the specified fire alarm and smoke detection system. Include all components, elements, and testing and acceptance procedures.
- D. If the submitted system is being supplied by an authorized distributor of the equipment manufacturer, the distributor shall have been actively engaged in the sale, installation and service of the type of system proposed for this project for a minimum of 10 years.
- E. Any proposed installer who cannot show evidence of such qualifications may be rejected. The services of a technician provided and certified by the equipment manufacturer shall be provided to supervise the installation and tests of the system.
- F. Furnish evidence there is an experienced and effective service organization, which carries a stock of repair parts for the system to be furnished.
- G. The installing contractor shall be licensed by the State Fire Marshall to design, sell, install, and service fire alarm systems as required.
- H. The installing contractor shall have on his staff a minimum of two (2) Fire Alarm Planning Superintendent (APS) licensed by the State Fire Marshall's office for such purpose.
- I. The APS shall be a certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place. In lieu of a NICET certified state licensed fire alarm planner, the contractor or supplier may provide design supervision by a registered professional engineer, who regularly engages in the design of fire alarm systems.
- J. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- K. Material shall be new and in perfect condition when installed.
- L. Electrical or electronic equipment provided under this Division which has been damaged, exposed to weather, or is, in the opinion of the Architect/Engineer otherwise unsuitable because of improper fabrication, storage, or installation, shall be removed and replaced with new equipment, at no additional cost to the owner.

1.05 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements

surrounding installation of the fire alarm system with all other trades.

1.06 DEFINITIONS

- A. General: Wherever mentioned in this specification or on the drawings, the equipment, devices and functions shall be defined as follows:
 - 1. Alarm Signal: A signal, which signifies a state of emergency requiring immediate action and immediate notification of the Fire Department. These are signals such as:
 - a. The operation of a manual station.
 - b. The operation of a fire suppression system switch.
 - 2. Pre-Alarm Signal: A signal, which indicates a detection device, has operated. These signals require and immediate response, but do not require immediate notification of the Fire Department.
 - 3. Supervisory Signal: A signal, which signifies the impairment of fire protection system, which may prevent its normal operation.
 - 4. Trouble Signal: A signal, which indicates that a fault, such as an open circuit or ground, has occurred in the system.
 - 5. Alarm Zone: An alarm initiating device or combination of devices connected to a single alarm initiating device circuit.
 - 6. Pre-Alarm Zone: A detector or group of detectors connected to a single detector circuit, which can send an alarm to the central control panel.
 - 7. Supervision Zone: A supervisory signal initiating device or combination of such devices connected to a single supervisory signal circuit.
 - 8. Communication Zone: A fire alarm indicating device or series of devices arranged to visually and/or audibly indicate a fire alarm signal.

1.07 SUBMITTALS

- A. Before the shop drawings are submitted to Architect / Engineer, submit drawings to the Authority Having Jurisdiction for approval. All approvals shall be noted on the drawings or by letter from the Authority Having Jurisdiction. Submit copies of the Authority Having Jurisdiction approved shop drawings to the Architect for review.
- B. Fire alarm submittal shall be bound and separate from all other submittals. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
 - 1. Provide a complete written, item-by-item, line-by-line, specification review stating compliance or deviation in full description.
 - 2. Complete point-to-point wiring diagrams of new equipment.
 - 3. Complete floor plan drawings locating all new system devices and existing panels used for expansion.
 - 4. Complete system bill of material.
 - 5. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
 - 6. Provide a complete description of system operation.
 - 7. Manufacturer's installation instruction.
 - 8. Bound form with contractor's name, supplier's name, project name, state fire alarm license, Fire Alarm Planning Superintendent license and all Technician(s) license adequately identified.

9. Submittal sheets sequentially numbered with the format: sheet number of number total. For example: 1 of 3.
10. Complete set of manufacturer's operating instructions, circuit diagrams and the information necessary for proper installation, operation and maintenance.
11. Field and factory wiring diagrams of all new systems and for typical devices showing all connections with all terminals and interconnections identified.
12. Complete schematic circuit diagrams for all new equipment, including panel modules.
13. Floor plan drawings including all existing main and new panel and device locations, conduit sizes between devices and panels; number, size and type of conductors between devices and panels; walls, doors and graphic room numbers; exact power requirements and conduit routing with the location of all junction boxes and exact locations of devices and equipment. Submit a floor plan drawing circuiting/zoning shall be identified on the drawings.
14. Complete wiring, routing, and schematic diagrams, software descriptions, and details required to demonstrate that the system has been coordinated and will function as a system.
15. Manufacturers catalog cut sheets shall be provide for each piece of equipment with the appropriate model or part number highlighted in cases where multiple model numbers or part numbers are shown.
16. Detailed list of all hardware components, which are included.
17. Installation details for each type of field mounted device installed under this contract.
18. Point-to-point termination schedules with cable identification numbers and terminal strip numbers.
19. New fire detection and alarm system's panel configuration complete with peripheral devices, batteries, power supplies, and interconnection diagrams.
20. Submit a riser diagram of trunk wiring and device-to-device wiring and device to fire alarm control panel wiring. Riser shall show:
 - a. Conduit sizes and types.
 - b. Number, size and type of conductors.
 - c. Fire detection and alarm devices arranged in the required circuiting/zoning, as defined in the specifications and on the drawing.
 - d. Battery calculations to show compliance with the requirements of the specifications for both alarm and supervisory mode.
21. Submit sound and visual level to confirm that number and location of signaling devices will provide required sound and visual levels throughout the building.
22. Sample of proposed graphic/text annunciation.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. Submit complete sets of operation and maintenance manuals. Manual, less as-builts, and sign-off sheets, shall be provided upon completion of the work. Approval of the manual will be required prior to substantial completion.
- B. The Operation and Maintenance Manual shall consist of the following:
 1. The manual shall include the names, addresses and telephone numbers of each Contractor installing products, and of the nearest service representative for each product. The manual shall have a Table of Contents and tab sheets. Update manuals to include modifications made during installation, checkout and

acceptance. The manual shall include the sections described in the following paragraphs.

2. The Functional Design Section shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. Hardware and software functions, interfaces, and requirements shall be provided for system operating modes.
3. The Hardware Section shall describe equipment provided, including general description and specifications, installation and checkout procedure, electrical schematics and layout drawings. Alignment and calibration procedures, manufacturer's repair parts list indicating source of supply, interface definition, signal identification and wiring diagrams. Also, include a complete parts list of all components as well as a list of recommended spare parts. The spare parts list shall include, for each item, the manufacturer's name, the model of the part, and serial number, if appropriate, and a physical and electrical description of the part.
4. The Software Section shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software module, to instruct the user on programming or reprogramming any portion of the system and other information necessary to enable proper system usage.
5. The Operation Section shall provide instructions for operation of the system, including system start-up procedures, use of system and applications software, alarm presentation (where applicable), failure and recovery procedures, preventive maintenance schedule, parameter schedules and sequence definition, and system access requirements.
6. The Maintenance Section shall provide descriptions of maintenance for equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
7. The Shop Drawings section shall include copies of all approved shop drawings and submittal materials updated to "AS BUILT".

1.09 AS-BUILT DRAWINGS

- A. Prepare and submit detailed "As-Built" drawings. The drawings shall include certified test of the system, testing and acceptance sign-off sheets, and other items specified elsewhere to be performed after initial submission of operation and maintenance manuals, complete wiring diagrams showing connections between all devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as built location of all devices and equipment. The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop drawings. The drawings shall be prepared on uniform sized sheets, the same size as the project drawings. The plan drawings shall be 11x17 inch and inserted in the specified Operations and Maintenance Manuals. Provide electronic copies in PDF and Autocad.dwg format.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers acceptable contingent upon Products' compliance with the specifications:
 1. Match Existing main fire alarm panel manufacturer.

2.02 SYSTEM DESCRIPTION

- A. System shall be a fully functional fire detection and alarm system, tested and left in first class operating condition. Voice evacuation systems where required or specified shall have voice alarm notification wherever audible notification is required.
- B. The system shall provide communication with initiating and control devices individually. All of these devices shall be individually annunciated at the fire alarm control panel. Annunciation shall include the following conditions for each point:
 - 1. Alarm
 - 2. Trouble.
 - 3. Open
 - 4. Short
 - 5. Device missing/failed.
- C. System circuits shall be wired as follows: Initiating device circuit (IDCs) shall be Style B, indicating appliance circuit (IACs) shall be Style Y, and signal line circuit (SLCs) shall be Style 4 as describe in NFPA 72.
- D. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.
- E. There shall be supervisory service initiation device circuits for connection of all sprinkler water flow switches and valves. Device activation shall cause a general alarm at the fire alarm control panel. Each flow and tamper switch shall have an individual address.
- F. There shall be independently supervised and independently fused indicating appliance circuits for all alarm signaling devices. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
- G. Auxiliary manual controls shall be supervised so that an “off normal” position of any switch shall cause an “off normal” system trouble.
- H. 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.
- I. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the building fire alarm control panel.
- J. The system modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- K. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.
- L. The system shall be provided with sufficient battery capacity to operate the entire system

upon loss of normal 120 VAC power in a normal or supervisory mode for a period of 24 hours with 20 minutes of alarm operation at the end of this period as a minimum. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. If batteries are fully discharged, the charger shall recharge them back to full charge in four hours.

- M. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the respective fire alarm control panel.
- N. All addressable devices shall have the capability of being disabled or enabled individually from the fire alarm control panel.
- O. A maximum of 90 addressable devices shall be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices within the capability of the designed system are unacceptable. Expansion of the designed system shall be accomplished by factory reprogramming.
- P. The communication format to the addressable devices shall be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- Q. Each addressable device must be uniquely identified by an address code. The system must verify that proper type device is in place and matches the desired software configuration. All remote or external panels shall have an individual address for monitoring.
- R. Wiring type, distances, survivability, and wiring configuration types shall be approved by the equipment manufacturer. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device on a Style Y circuit. Fire alarm cable shall have an outer jacket insulation color of red. Minimum wire size shall be #18 AWG.
- S. Each panel extender shall have an individual address.

2.03 FIRE ALARM CONTROL PANEL (FACP)

- A. Existing to remain.
- B. The fire alarm control panel shall be left with 25% spare initiating point and battery capacity for future use.
- C. New power supplies (if required) shall provide all control panel and peripheral power needs with filtered power as well as unregulated 24VDC power for external audio-visual devices. The audio-visual power shall be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet UL and NFPA requirements for POWER LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits. Design the system power supplies and power trunk wiring for all annunciation devices required, and to add a minimum of two (2) 110cd visual devices in the future. Individual circuit design loading shall not exceed

70% of power supply and system wiring capacity when including the additional spare capacity for the 110cd visual devices

1. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide positive and negative ground fault supervision, battery/charger fail condition, and AC power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
2. Surge protection shall be integral to the control panels.
3. Each power supply shall be monitored and have an individual address.

2.04 DIGITAL FIRE ALARM COMMUNICATOR

- A. Existing to remain.

2.05 EMERGENCY VOICE ALARM COMMUNICATION SYSTEM

- A. Existing to remain.

2.06 NEW FIELD DEVICES WHERE REQUIRED

- A. All devices shall be supervised for trouble conditions. The fire alarm control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Should a device fail, it shall not hinder the operation of other system devices.
- B. Visual Signals
1. Strobe lights shall be low profile and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA and UL 1638 requirements, and 15, 30, or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Provide white with red letters.
 2. All wall mounted strobe units installed in student's toilets, gymnasiums, corridors, student locker/dressing rooms, kitchen preparation and serving areas, vocational shops, athletic/drill team training rooms, in cafeterias, and commons areas, shall have a protective cover, STI Stopper #STI1221E Series. Provide enviro kit for locations where dampness, water or dust is present.
- C. Combination Alarm Signal and High Intensity Visual Signals
1. Strobe lights shall be low profile and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Each unit shall provide a Code 3 Temporal tone. The horn shall be capable of an output of 95dB at 10', and intensity adjusted accordingly for the area of coverage. Electronic Mini-Sounder or horn set on low setting shall be provided in interior rooms 900 square feet or less. Mini-sounder shall not be used in any corridors, mechanical electrical rooms and similar large spaces and areas of high ambient noise level. Provide white with red letters.
 2. All wall mounted combination units installed in student toilets, gymnasiums, corridors, student locker/dressing rooms, kitchens, preparation and serving area,

- vocational shops, athletic/drill team training rooms, cafeterias, and commons areas, shall have a protective cover, STI Stopper #STI1220E Series. Provide enviro kit for locations where dampness, water or dust is present.
3. The audible emergency alarms shall produce a sound that exceeds the prevailing sound level in the room or space by at least 15 dba or shall exceed any maximum sound level with a duration of 60 seconds by 5 dba, whichever is louder. Sound levels for alarm signals shall not exceed 110 dba at the minimum hearing distance from the audible appliance.
- D. Exterior Audible Signal:
1. Semi-flush mounted, molded of high impact red thermoplastic and listed for weatherproof locations.
- E. Combination Voice Signal and High Intensity Visual Signals (where indicated or required by local AHJ):
1. Strobe lights shall be of the electronic flashing xenon strobe type and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash.
 2. All combination units installed in student toilets, gymnasiums, corridors, student locker / dressing rooms, kitchens, vocational shops, athletic / drill team training rooms, cafeterias, commons areas, shall have a protective cover, STI Stopper #STI1220E Series. Provide enviro kit for locations where dampness, water or dust is present.
 3. The visual signal lens housing shall be white with red lettered FIRE or as approved by Architect. The speaker and visual signal shall be mounted to a common white speaker baffle. The visual signal shall flash at a rate of minimum of 1 Hz and maximum of 3 Hz, and shall use a xenon strobe type lamp or other high intensity long life light source. The lamp intensity shall be a minimum of 75 candela.
 4. The speaker shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. High output speakers, UL minimum 87dB at 10 feet with speaker taps of .33.66/1.25/2.5 watts. Standard output speakers, UL 75-81 dB at 10 feet with speaker taps of .5/1/1.75/2.75 watts. Capacitor for line supervision.
- F. Ceiling mounted recessed mounted speakers (where indicated or required by local AHJ) shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. UL minimum 78-87 dB at 10 feet with speaker taps of .25, .5/1.0/2.0 watts. Round, white baffle or 2x2 lay-in grid with UL enclosure, tile bridge supports when recessed in lay-in ceiling tiles (where indicated or required by local AHJ) and capacitor for line supervision.
- G. Surface mounted speakers (where indicated or required by local AHJ) shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F UL minimum 100 dB at 15 watts at 10 feet. Speaker taps via 7-position selector switch, 25-vol., .48/.94/1.8/7.5/15 watts. Fully enclosed wiring terminals. Capacitor for line supervision.

- H. Manual Pull Station: Addressable pull stations shall contain electronics that communicate the station's status (alarm, normal) to the control panel over two wires which also provide power to the pull station. They shall be manufactured from high impact red Lexan with white lettering. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations shall be double action without glass rods. The front of the station shall be hinged to a back plate assembly and shall be opened with a key to reset the station. The key shall be common with the control panels. The addressable manual station shall have address setting programmed electronically and automatically from the fire alarm control panel. Manual stations shall be designed for semi-flush (surface) mounting on standard electrical box. All pull stations units shall have a protective cover, STI Stopper II #STI-1130 surface mounted cover with local alarm horn. Provide STI, Weather Stopper II #STI3150 for locations where dampness, water or dust is present.
- I. Intelligent Multi-Criteria Photoelectric Smoke Detectors
1. The intelligent multi-criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.
 2. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.
 3. The detectors shall provide address setting means electronically and automatically at the control panel.
 4. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 5. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base. No radioactive material shall be used.
 6. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
- J. Intelligent Photoelectric Smoke Detectors
1. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.
 2. The detectors shall provide address setting means electronically and automatically at the control panel.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in

regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.

4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base. No radioactive material shall be used.
5. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.

K. Duct photoelectric smoke detectors:

1. Detectors shall be analog addressable type.
2. To minimize nuisance alarms, detectors shall have an insect screen and be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive material shall be used.
3. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control panel.
4. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
5. Remote alarm/power LED indicator with test switch shall be provided. Unit shall be wall or ceiling mounted in readily visible and accessible area near the location of detector; exact location of unit to be approved by the Architect/Engineer.
6. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type photoelectric smoke sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the requirement of interface zone modules.
7. The unit shall consist of a clear molded plastic enclosure (or remote mounted LED status indicator shall be provided next to the smoke detector) with integral conduit knockouts to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit's sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination.
8. The detectors shall provide alarm and power status indication by LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. Steady illumination of the LED shall indicate that the control panel has detected and verified an alarm condition. An output connection shall also be provided in the base for connecting an external remote alarm LED.
9. The detectors shall provide address setting means electronically and automatically from the control panel.

L. Intelligent Thermal Detectors

1. The detectors shall use dual electronic thermostats to measure temperature levels in its chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
2. The detectors shall provide address setting means electronically and automatically at the control panel.
3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.

4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base.
 5. Thermal Detectors shall be combination rate-of-rise and fixed temperature- rated at 135°F for areas where ambient temperatures do not exceed 100°F and shall be 200°F for areas where ambient temperatures exceed 100°F but not 150°F. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft. Detectors shall have a smooth ceiling rating of 2,500 square feet. Detectors shall be located as shown on the drawings and where required by local code authority.
 6. Provide fixed temperature 190°F detector in kitchen and kiln room in lieu of combination rate-of-rise / fixed-temperature type.
- M. Auxiliary AHU Relays: Air Products model MR-101C relays shall be provided for HVAC and AHU control and interface. Relays shall be heavy-duty type with contacts rated up to 10 amps at 120V AC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with DPDT contacts as well as activated LED indicator.
- N. Voltage sensing relays: Addressable control modules for voltage sensing relay interface shall be FCM-1.
- O. Monitor Module:
1. Addressable monitor modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.
 2. The monitor module shall provide address setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the monitor module is operational and in regular communication with the control panel, and indicate detection of an alarm condition.
- P. Control Module
1. Control/relay modules shall be provided where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The zone may be wired class A or class B - field selected. The control module may be optionally wired as dry contact (form C) relay.
 2. The control module shall provide address setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the control module is operational and in regular communication with the control panel and indicate when the device is actuated via the fire alarm control panel.
- Q. Auxiliary Interface Points: All auxiliary input points (kitchen hoods, water flow, tamper switches, fire extinguishing systems etc.) shall be connected as required, and addressed as a separate initiating point of annunciation at the fire alarm panel and any remote annunciator as required.
- R. Water flow switches / Valve supervisory switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor. Wiring of these field devices to the fire alarm system shall be the responsibility of the fire alarm contractor. It

is the responsibility of this contractor to ensure the proper function of the system. Each fire protection zone (flow switch) and (Valve switch) shall be addressed electronically and automatically at the control panel as a separate point of annunciation at the fire alarm panel. Coordinate exact location with fire protection contractor and civil drawings.

2.07 MAGNETIC DOOR HOLDERS, AUTOMATIC FIRE DOORS / SHUTTERS, AND SECURITY GRILLES AND INTERIOR SPACE CONTROLLED ACCESS EGRESS DOORS WITH AUTOMATIC EMERGENCY EGRESS ELECTRIC LOCK EMERGENCY RELEASE

- A. Magnetic fire door hold open devices, interface for automatic roll down fire doors/shutters, and interface for security grilles and controlled access egress doors with emergency egress shall be provided. Coordinate with Division 8 and Architectural Drawings for exact location.
- B. The operation of any alarm in the fire alarm system shall cause the following:
 - 1. Release of the magnetic fire door holding devices, permitting the fire doors to be closed by the door closer.
 - 2. Permit the automatic roll down fire doors/shutters to close automatically.
 - 3. Permit the security grilles with emergency egress to open automatically.
 - 4. Unlock the electrically controlled access doors in all interior spaces.
- C. The magnetic door holders, automatic roll down fire doors/shutters, security grilles, and interior electrically controlled access doors with emergency egress, shall be associated with two smoke detectors located on the ceiling with one on either side of the fire door/shutter, security grille opening, or interior egress path electrically controlled door. The operation of either of these detectors shall also cause the magnetic holder to release the fire door, the automatic fire door/shutter to close, and the security grille with emergency egress to open.
- D. The operation of smoke detectors associated with a magnetic door holder, automatic roll down fire door, security grille, or electrically controlled access door shall transmit a pre-alarm signal to the fire alarm panel.

2.08 REMOTE PAGING UNIT

- A. Remote all-call paging unit or to activate one of the pre-recorded messages over the speaker circuits.

2.09 REMOTE ALPHANUMERIC DISPLAY ANNUNCIATORS

- A. (Where indicated or required by Local Authority Having Jurisdiction) Remote alpha-numeric annunciator(s) to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator(s) shall be an 80-character display similar to the main FACP and operate via the system RS485 or RS232 serial output terminal from the main FACP. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote annunciator(s) shall include:
 - 1. Integral time/date clock
 - 2. System reset
 - 3. System silence

4. System acknowledge
 5. Display/step switch
 6. Integral trouble buzzer
 7. LCD contrast adjust
 8. Fire Drill Operation
- B. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The following primary controls shall be visible through a front access panel:
1. 80 character alphanumeric display, LCD, LED, or gas plasma
 2. Individual red system alarm LED
 3. Individual yellow supervisory service LED
 4. Individual yellow trouble LED
 5. Green "POWER ON" LED
 6. Alarm acknowledge key
 7. Trouble acknowledge key
 8. Alarm silence key
 9. System reset key
 10. LED test

PART 3 - EXECUTION

3.01 EXPANSION OF EXISTING SYSTEM

- A. Testing of existing systems:
1. Provide complete operational test of existing fire alarm system prior to any demolition or construction. Verify operation of each device, control panel, distribution equipment and associated accessories.
 2. Provide a complete written report to the Architect, indicating any deficiencies of the existing system in relation to each component's intended function. In addition, provide deficiencies of the existing system with regard to current Code, ADA, and Local Accessibility Standards requirements. Provide the written report 14 days prior to any work related to the expansion of the existing system.
 3. Testing of the existing system shall include all areas and all buildings served by the existing system.
- B. Expand the existing system in all expansion or renovation areas to include requirement specified and as required by the local authority having jurisdiction. Verify compatibility of new equipment with existing system.
- C. Provide audio and visual alarm devices in all areas normally occupied by students or minors. The renovated and expansion areas' audio alarm shall be equipped with voice alarm capability regardless of local AHJ requirements. Existing areas shall remain temporal audio alarm only.

3.02 GENERAL REQUIREMENTS

- A. Installation shall include the delivery, storage, setting in place, fastening to the building structure, interconnection of the system components, alignment, adjustment and all other work, whether or not expressly specified, which is necessary to result in a tested and operational system.

- B. All installation practices shall be in accordance with, but not limited to, the specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements and recommendations of the National Electrical Code and any authorities having jurisdiction. Proper protection against corrosion shall be provided on all electrical equipment in accordance with the requirements of the National Electrical Code. The installation shall conform to all manufacturers' recommendations.
- C. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and support shall be adequate to support their loads with a safety factor of at least three.
- D. All boxes, equipment, etc., shall be plumb and square. The contractor must take such precautions as are necessary to prevent and guard against electrostatic hum, to supply adequate ventilation, and to install the equipment to provide reasonable safety for the operator.
- E. In the installation of equipment and cables, coordinate with Architectural drawings for possible conflicts with millwork, casework, marker boards, furniture, lockers, etc., and notify the architect of any discrepancies. Verify modifications before proceeding with installation.
- F. Mount end-of-line resistor for each box circuit in backbox located at the last manual alarm station or automatic initiating device in a circuit. Mark device accordingly in the field.
- G. Contractor shall submit on completion of system verification, a point-by-point check list indicating the date and time of each item inspected and issue a certificate confirming that the inspection has been completed and the system is installed and functioning in accordance with the Specifications prior to date of substantial completion.
- H. Provide remote alphanumeric display annunciators as required by the Local Authority Having Jurisdiction and/or where indicated on the drawings.
- I. Provide remote paging units adjacent to each remote alphanumeric display communicator for voice alarm system.
- J. Alarm devices shall be ceiling mounted unless indicated specifically otherwise. Alarm devices in Mechanical, Electrical, Communications, IDF / MDF Rooms and Central Plant shall be wall mounted and coordinated with other equipment, piping and ductwork.
- K. Detectors shall be installed per NFPA 90A and be listed with the fire alarm control panel.
- L. Power for magnetic door holders should be provided from the nearest receptacle circuit wired through fire alarm relay.
- M. Smoke detectors shall be mounted to a 4-inch octagon box with hanger bar or with box secured to building structure.
- N. Provide power via 120-volt, 20-Amp dedicated circuits with lock-on provisions at the

respective circuit breaker for each new main fire alarm control panel, each new panel extender and each new remote power supply at no additional cost to the Owner. The complete fire alarm system shall be powered under emergency power when emergency life safety power is available at the project site. When emergency life safety power is not available at the project site, power shall originate from the nearest available 120-volt panel, or as indicated.

3.03 CABLE AND BOXES INSTALLATION

- A. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions, which might adversely affect the connected devices. Each individual signaling circuit shall be classified as a circuit pair.
- B. All cabling in racks, cabinets and junction boxes shall be neatly strapped, dressed and adequately supported. Cable installation shall conform to good engineering practices and to the standards of the National Electrical Code.
- C. Cables shall be terminated with the proper connector required for the associated operation of the equipment to which it is connected. Screw terminal blocks shall be furnished for all cables, which interface with racks, cabinets, consoles or equipment modules.
- D. All cables within a rack, console or junction box shall be grouped according to the signals being carried to reduce signal contamination.
- E. Where shielded conductors enter a panel or enclosure, and where power wiring exists, provision shall be made to provide physical isolation of signal and power conductors.
- F. Supply and install all fittings and accessories whether or not they are specified, required for proper, safe and reliable operation of the system.
- G. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit fill shall not exceed 40%.
- H. Minimum conduit size shall be 3/4" EMT with insulated bushings. Install conduit per engineered shop drawings.
- I. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed to view and or subject to damage.
- J. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- K. All junction boxes containing fire alarm wiring are to be painted red.
- L. All plenum wiring is to be installed parallel and perpendicular to the building structure. Cable shall be bundled with cable ties on a maximum of 2'-6". Install cables in D-ring

hangers secured to the structure at a maximum of 5' on center. Cable shall not lie on ceiling grid or ceiling tiles, light fixtures, piping, ductwork or foreign equipment.

- M. The system ground is to be connected to the local ground bus. Under no conditions shall the AC neutral either in a power panel or in receptacle outlets be used for a reference ground.
- N. All wiring shall be in accordance with NFPA 72, the National Electrical Code, and Local Codes. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- O. All wire shall be UL Listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 and approved by the local authority having jurisdiction.
- P. No other wiring shall be run in the same conduit as fire alarm wiring.
- Q. All fire alarm wiring to be red. All fire alarm circuits shall be identified at each termination and at each 25 feet between terminations.
- R. Copper wiring leaving or entering main building shall be protected on both ends with surge suppression; otherwise use fiber-optic cabling.

3.04 ALARM SYSTEM SEQUENCE OF OPERATION

- A. General:
 - 1. All fire alarm circuits shall be electrically supervised.
 - 2. Automatic response functions shall be accomplished by the first device initiated. Alarm functions resulting from initiation by the first device shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. A pre-alarm signal shall have second priority and supervisory or trouble signals shall have third and fourth level priority. Signals of a higher level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first.
- B. Fire alarm operating sequences shall be as follows:
 - 1. Activation of any automatic detector, manual station, or sprinkler flow switch shall cause the location of alarm to be identified in an audible and visual manner at the building fire alarm control panel (FACP), and shall initiate the following events:
 - a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED to a steady state.
 - b. The 80-character display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.

- c. Any remote or local annunciator LED's associated with the alarm point shall be illuminated as herein specified.
 - d. The remote signaling connection shall be activated relaying the alarm signal to an approved central station (central station connection and service provided by Owner). Point ID and descriptor must be sent and received.
 - e. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
 - f. Activate all audible/visual alarm devices. Where prerecorded voice announcement is required or specified, the prerecorded announcement shall be preceded with attention tone(s), followed by the approved prerecorded announcement and continue in a cycle until the system is reset. Manual voice announcement shall interrupt the prerecorded cycle and the prerecorded cycle shall resume automatically after three minutes.
 - g. De-activate all HVAC systems.
 - h. De-energize the kitchen hood supply/exhaust fans as required by local authority having jurisdiction.
 - i. Close all related smoke dampers.
 - j. Close all related smoke/fire dampers.
 - k. Release all magnetic door hold open devices.
 - l. Open all security grilles with emergency egress.
 - m. Activate to close all related fire and smoke doors and shutters.
 - n. Activate signaling connection to the elevator as required by the local authority having jurisdiction.
 - o. Signal the building automation system and security system, and Owner's security/police personnel as directed by Owner/Architect. The audible alarms shall be inhibited from being silenced for a period of 3 minutes after commencing operation unless alarm is acknowledged and appropriate action has been taken.
 - p. Release the electric strike, unlocking, but not unlatching, locked doors controlled by an access control system. Release Counter Shutters and hold-open devices on all fire and smoke doors.
 - q. Activate automatic recall operation of elevators as required by local authority having jurisdiction.
 - r. Record all events on the system printer when an existing printer is part of the system.
2. Activation of duct mounted smoke detector on the HVAC equipment, or a smoke detector mounted in the return/supply air stream of any fan shall shut down all units as required by NFPA. The activation of one of these detectors shall initiate the Alarm Sequence of Operation.
3. Activation of a control valve supervisory switch shall initiate the following events:
- a. The activation of any sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the building fire alarm control panel (FACP). Differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring shall be provided.
 - b. Activation of a sprinkler system control valve supervisory switch shall not prevent the events listed under Article 3.4.
 - c. Restoring the valve to the normal position shall cause the supervisory

service audible signal to pulse, indicating the restoration to normal position. The supervisory service reset key shall be provided to silence the audible signal.

4. Activation of the smoke detector and heat detector in the elevator machine room and at top of elevator shaft shall cause the elevators' controllers to be tripped by way of the shut trip breaker, and shall also initiate the events listed under Article 3.4.
 5. Any subsequent fire alarm shall reactivate the alarm indicating appliances and activate the respective control sequences described above.
 6. Upon reset of the fire alarm control panel, HVAC units shall be capable of being started, and resume normal operation.
- C. Activation of the manual evacuation pull station shall operate the alarm indicating appliances without causing other control circuits to be activated. However, should true alarm occur, all alarm functions should occur as described.
- D. ALARM VERIFICATION shall be field programmed for each respective detector. Global verification will not be acceptable. The verification sequence is activated after a "check" procedure and the panel will wait a field programmable delay period (0-50 seconds) then proceed to re-sample the detector for continued presence of smoke. If the alarm condition still exists or a non-verified device is actuated during the verification period, the system will then initiate all alarm sequences specified herein. The system shall incorporate the ability to log in memory the number of verification events that have occurred for each selected device.

3.05 EQUIPMENT IDENTIFICATION

- A. Each new panel or equipment enclosure shall be provided with a permanently engraved or embossed or silkscreen identification tag. The tag shall include the following information:
1. Name of manufacturer.
 2. Manufacturer's equipment description.
 3. Serial number and model number.
 4. Voltage and current rating.

3.06 SPARE PARTS AND TOOLS

- A. Interchangeable Parts: All spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the site in unopened cartons for storage as directed by the Owner.
- B. Spare Parts: Provide minimum of one, or 5% of renovation area total, whichever is greater unless noted otherwise.
1. Spare shut down modules
 2. Spare detectors of each type in the system
 3. Spare alarm indicating devices of each type in the system
 4. Spare manual pull stations
 5. Spare protective covers of each type in the system.
 6. Spare relays/controls required for connection to smoke and fire/smoke dampers

- 7. Devices listed above are to be installed as directed by Architect/Engineer or local code authorities at no additional cost to the Owner. Unused spare parts are to be parts for Owner's cabinet.
 - 8. Provide one telescopic pole for each type of area detector located above 12 feet AFF to facilitate removal and installation of detector head.
- C. Provide two copies of the final software programmed into the fire alarm system.
 - D. Parts list: Furnish a list, in duplicate, of all other parts and accessories the manufacturer of the system recommends to be stocked for maintenance.

3.07 KEYS

- A. Keys and locks for all equipment shall be identical to the existing building master key for the fire alarm system.

3.08 SMOKE DAMPERS AND FIRE/SMOKE DAMPERS

- A. Smoke dampers and combination fire/smoke dampers shall be controlled by an automatic alarm initiating device. Smoke dampers installed to isolate the air handling system shall be arranged to close automatically when the system is in alarm.
- B. Coordinate motor operator voltage with supplier.
- C. Open all dampers prior to starting air handling equipment.
- D. Provide 120V power from nearest general purpose 20A receptacle circuit as required, or as noted otherwise.

3.09 GRAPHIC FLOOR PLANS

- A. Provide updated color coded floor plan detailed with actual room names, actual graphic room numbers as directed by the Owner and adequate information to direct people to the fire alarm devices in alarm and to exits with non-fading floor plan media. Do not use architectural plan room names and numbers.
- B. Each plan shall clearly relate the room numbers on the annunciator to the area description on the floor plan. All fire alarm devices located to correspond with the annunciator.
- C. The floor plan shall be solvent welded in acrylic plastic.
 - 1. Mount in an extruded aluminum frame next to the main fire alarm control panel.
- D. Install graphic floor plans as directed by Architect/Owner prior to substantial completion. Each area or room designation shall be verified with the fire alarm device during testing.

3.10 ADDITIONAL REQUIREMENTS

- A. Coordinate with Owner for appropriate off-site monitoring service and communication technology to be used. Provide all necessary programming for interfacing with the Owner's on-site and off-site remote signaling receiving station, including programming

of descriptors and addresses at the receiving station.

- B. The contractor is to ensure all areas of the renovation and new construction are covered with visual and audio alarm devices for occupant notification of a fire alarm including remote portable or temporary buildings.
- C. Coordinate door hold devices with door and door hardware.
- D. Provide interface with and coordinate shunt-trip circuit breakers and control devices with kitchen hood fire control systems (where new kitchen hood fire control systems are provided) and elevator equipment (where new elevators are provided).
- E. Alarm circuit power supplies and circuiting shall be designed and installed to accept an additional five (2) 110cd visual devices for future expansion. The initial design shall not exceed 70% of the rated power supply and circuit capability with the two additional 110cd devices installed.
- F. Provide programming or re-programming of all hot keys as directed by Owner including, but not limited to, fire drill, AHU shutdown bypass, horn/strobe disable, elevator test.

3.11 COMMISSIONING THE SYSTEM

- A. The installing contractor shall be responsible for verifying that each new or relocated component of the system is fully operational and in conformity with the specifications. He shall also be responsible for insuring that all elements function together as a system in accordance with the specifications.
- B. A state licensed and factory trained technical representative of the manufacturer with NICET Level 3 minimum certification shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
- C. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. Any new or relocated items located within the construction or renovation area found not properly installed or non-functioning shall be replaced or repaired and retested. The final test indicating a fully functional fire alarm system shall be recorded; electronic Excel and printed copy submitted to the Architect, Engineer and Owner.
- D. The installing contractor shall provide a complete written report and printout of the functional test of the entire system after all existing deficiencies of the existing system have been corrected by the Owner, or as directed by the Owner. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout. This test shall be completed and accepted by the Owner prior to testing for the local Fire Marshall.
- E. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections, as may be required by the local authorities. The Contractor shall affix his certification label and installation certificate to

the interior of the main fire alarm control panel.

- F. The testing and acceptance shall be performed within 30 days after the fire alarm installation is completed. The test shall be performed by a minimum of two qualified fire alarm system technicians acceptable to the authority having jurisdiction. The test which is a comprehensive 100 percent inspection and test of all fire alarm system equipment shall include the following:
1. Fire alarm control equipment: a visual and functional test of the fire alarm control and auxiliary control equipment.
 2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
 3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that wiring is properly supervised as required.
 4. Indicators shall be tested to ensure proper function and operation.
 5. Control panel auxiliary functions shall be functionally tested to verify proper operation.
 6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A three-minute general alarm stress test, both under AC power and standby power, shall be conducted to further ensure complete operation of the system.
 7. Fire alarm peripheral devices; All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
 8. Manual initiating devices:
 - a. Each manual fire alarm station shall be functionally tested for alarm operation.
 - b. Each manual fire alarm station shall be functionally tested for proper wiring supervision.
 9. Automatic initiating devices:
 - a. Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
 - b. Each automatic initiating device shall be functionally tested for proper wiring supervision.
 - c. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specifications.
 10. Alarm signaling devices:
 - a. Each alarm signaling device shall be tested and decibel reading taken at 10' from the device and recorded to ensure proper operation. Each area's voice alarm signaling devices shall be tested for intelligibility.
 - b. Each alarm signaling device shall be functionally tested for proper wiring supervision.
 - c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
 - d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
 11. Elevators: Each elevator shall be tested and automatic recall function verified.
 12. Reporting: Upon completion of the initial verification audit, a report shall be sent to the Architect/Engineer indicating that all fire alarm equipment has been tested and is in 100 percent operation. The report shall also contain the audit testing

information as to the location and operational status of each peripheral device.
The 100 percent audit shall be performed by a factory-trained representative. The report shall include the voice intelligibility performance in each area and indicate compliance with NFPA and local AHJ requirements.

- G. It is the intent of these specifications and of the Architect/Engineer that a continued program of system maintenance will be provided by the Owner in compliance with NFPA 72. It is mandatory that the installing Contractor provide such services and make available these services to the Owner upon completion of the project.
- H. Upon completion of installation and full acceptance testing, submit NFPA 72 certificate of compliance that the total fire alarm system, including any subsystems, is fully functional and that the components are UL listed for function intended.

3.12 SUBSTANTIAL COMPLETION

- A. Final acceptance of the FIRE ALARM SYSTEM by the owner, local code authorities and Occupancy Permit has been issued.
- B. All fire alarm system shop drawings, operating and maintenance manuals, maps and as-built drawings shall be submitted to and accepted by the Architect / Owner prior to date of substantial completion.

3.13 WARRANTY

- A. All new fire alarm devices, new panels, new equipment and new accessories, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of substantial completion. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner within 4-hour notification.
- B. Repair services and replacement parts for the system to be furnished under this Contract shall be available for a period of ten years after the date of final acceptance. Service during the warranty period shall be provided within four hours after notification and all repairs shall be corrected within 24 hours after notification throughout the warranty specified in this section.
- C. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- D. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.
- E. Provide a certified fire alarm test of the complete system at the end of the warranty period and correct any and all items located in the area of renovation to bring the system to an approved status at no cost to the Owner. Clean all smoke detectors and replace all defective parts within the area of renovation at no cost to the Owner.
- F. Guarantee labor, materials, and equipment provided under this contract against all defects for a period of one year after the date of final acceptance and receipt and approval of

“As-Built” drawings and schematics of all equipment.

END OF SECTION 28 31 02

SECTION 31 21 00
EARTH MOVING

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
- B. Refer to the geotechnical report for this project for further information available at the Architects office.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for buildings.
 - 2. Excavating and backfilling for buildings and structures.
- B. Related Sections include the following:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 03 Section "Cast-in-Place Concrete".

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Drainage Course: Course beneath the slab that minimizes upward capillary flow of pore water.
- E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- F. Fill: Soil materials used to raise existing grades.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.4 SUBMITTALS

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
 2. Test reports on borrow material.
 3. Field density test reports.
 4. One optimum moisture-maximum density curve for each type of soil encountered.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform work in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- C. Testing & Inspection Service: Owner will engage and pay for soil testing and inspection service for quality control testing during earthwork operations. Contractor shall pay for all retesting of failed tests.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Existing Utilities: Locate existing underground utilities before performing earthwork. If utilities are to remain in place, provide protection from damage during earthwork operations.
- C. Interruption of Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soils:
 - 1. Imported soil fill material used to raise the site grade shall be clean riversand fill that shall be free of roots, construction debris, organic matter or any other deleterious materials.
- B. Unsatisfactory Soils: Soils other than satisfactory soils.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 0 to +3 percentage points of the optimum moisture content at time of compaction as determined by the Standard Proctor test (ASTM D 698).

- C. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

- B. In order to prepare the building and pavement areas for fill or for insitu soils to be used as a final subgrade, the site shall be stripped of all vegetation, soft or loose surface soils, obstructions and all deleterious materials. This includes any loose or water-softened surface materials.
 - 1. When trees are removed, the entire root ball shall be excavated such that the remaining roots measure 1/2 inch in diameter, or less.
 - 2. Strip 6 inches of topsoil minimum at building pad, within 10 feet of the building limits and 5 feet beyond the toe of structural fills. Additional stripping may be required in some areas. The actual removal depth shall be determined in the field by the Testing Agency.
- C. Additional information for preparation requirements of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface, and treatment or improvement are specified in Division 31 Section "Site Clearing."
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.
- E. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated materials as directed by Architect.
- F. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction (including all OSHA requirements). Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
- G. See Section 3.7 below for required proofroll of existing subgrade to be performed immediately after preparation work noted above is complete.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Avoid opening excavations during inclement weather.
- C. Excavations shall not have deleterious effects on adjacent foundations or structures. Sequence construction as required to avoid deep excavations adjacent to foundations or structures, or when deep excavations adjacent to foundations or structures are unavoidable, provide temporary shoring as required in consultation with Geotechnical Engineer.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
 3. The base of all excavations for structures shall be free of water, loose soil, unsuitable bearing materials including soft soil, and other foreign materials.

3.6 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.

EARTH MOVING

- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll existing subgrade (after preparation as noted above has been completed) below the building slabs with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Contact Architect, Engineer, and Testing Agency 48 hours prior to proof-rolling. A representative of the Testing Agency must be on site during proof-rolling operations.
 - 2. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 3. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 4. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Testing Agency and as directed by Architect, and replace with compacted backfill or fill as directed.
 - a. Prior to consideration of removal and replacement of existing soils, drying and processing of existing subgrade for three consecutive dry days shall be performed as described in Section 3.1 and existing subgrade shall be retested by proof-roll immediately after drying and processing period is complete.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2000 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under steps and ramps, use satisfactory soil material.
 - 2. Under building slabs (and within 10 feet of building slab edges), use satisfactory soil material.
 - 3. Under footings and foundations, use satisfactory soil material
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.11 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 0 to +3 percentage points of the optimum moisture content at time of compaction as determined by the Standard Proctor test (ASTM D 698).
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds the optimum moisture content allowance stated above and is too wet to compact to the specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials only after the site has been proof-rolled.
- B. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Compact all satisfactory soil materials to at least 95 percent of the maximum dry density as determined by the Standard Proctor compaction test (ASTM D 698).

3.13 GRADING

- A. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

3.14 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

- C. Provide inspections and test in accordance with Chapter 17 of the International Building Code.
- D. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- E. Testing agency will test compaction of soils in place according to ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937 and ASTM D 698, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 100 feet or less of trench length, but no fewer than 2 tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.
- G. Testing agency shall verify materials below shallow foundations are adequate to achieve the design bearing capacity.

3.15 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect (or Engineer); reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off of Owner's property.

END OF SECTION 31 21 00

SECTION 31 31 16
TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chemical soil treatment.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.

1.03 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2019.

1.04 SUBMITTALS

- A. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- B. Qualification Data: For Installer of chemical soil treatment.
- C. Soil Treatment Application Report: Including the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Brand name and manufacturer of termiticide.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes and rates of application used.
 - 6. Areas of application.
 - 7. Water source for application.

- D. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of three (3) years experience.
 - 2. Licensed in the State in which the Project is located.

1.06 WARRANTY

- A. Provide five year installer's warranty against damage to building caused by termites.
 - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Manufacturers:
 - 1. Aventis Environmental Science USA LP; Product Termidor.
 - 2. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.
 - 3. Dow AgroSciences LLC; Product Dursban TC Equity.
- D. Mixes: Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.
- C. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control.

3.02 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.

3.03 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. In Crawl Spaces.
 - 3. At Both Sides of Foundation Surface.
 - 4. At Slab Penetrations.
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.04 PROTECTION

- A. Do not permit soil grading over treated work.

END OF SECTION 31 31 16

SECTION 32 13 13
CONCRETE PAVING

1. **QUALITY ASSURANCE**
 - A. READY-MIX-CONCRETE MANUFACTURER QUALIFICATIONS: A FIRM EXPERIENCED IN MANUFACTURING READY-MIXED CONCRETE PRODUCTS AND THAT COMPLIES WITH ASTM C94 REQUIREMENTS FOR PRODUCTION FACILITIES AND EQUIPMENT.
2. **CONCRETE, GENERAL**
 - A. ACI PUBLICATIONS: COMPLY WITH ACI 301 UNLESS OTHERWISE INDICATED.
3. **STEEL REINFORCEMENT**
 - A. PLAIN-STEEL WELDED-WIRE REINFORCEMENT: ASTM A1064, FABRICATED FROM AS-DRAWN STEEL WIRE INTO FLAT SHEETS.
 - B. DEFORMED-STEEL WELDED-WIRE REINFORCEMENT: ASTM A 1064/A 1064M, FLAT SHEET.
 - C. REINFORCING BARS: ASTM A615, GRADE 60; DEFORMED.
 - D. JOINT DOWEL BARS: ASTM A615, GRADE 60 PLAIN-STEEL BARS. CUT BARS TRUE TO LENGTH WITH ENDS SQUARE AND FREE OF BURRS.
 - E. BAR SUPPORTS: BOLSTERS, CHAIRS, SPACERS, AND OTHER DEVICES FOR SPACING, SUPPORTING, AND FASTENING REINFORCING BARS, WELDED-WIRE REINFORCEMENT, AND DOWELS IN PLACE. MANUFACTURE BAR SUPPORTS ACCORDING TO CRSI'S "MANUAL OF STANDARD PRACTICE" FROM STEEL WIRE, PLASTIC, OR PRECAST CONCRETE OF GREATER COMPRESSIVE STRENGTH THAN CONCRETE SPECIFIED.
4. **CONCRETE MATERIALS**
 - A. CEMENTITIOUS MATERIALS: USE THE FOLLOWING CEMENTITIOUS MATERIALS, OF SAME TYPE, BRAND, AND SOURCE THROUGHOUT PROJECT:
 1. PORTLAND CEMENT: ASTM C150, TYPE I OR TYPE II.
 2. FLY ASH: ASTM C618, CLASS F.
 - a. PRODUCT SHALL BE RESTRICTED TO SUPPLIERS AND SOURCES PROVIDED ON LA DOTD QPL 50.
 - B. AGGREGATES: ASTM C33, UNIFORMLY GRADED. PROVIDE AGGREGATES FROM A SINGLE SOURCE.
 1. MAXIMUM AGGREGATE SIZE: NO GREATER THAN 1/4 OF THE DEPTH OF EACH RESPECTIVE SLAB THICKNESS.
 - C. AIR-ENTRAINING ADMIXTURE: ASTM C260.
 - D. CHEMICAL ADMIXTURES: ASTM C494. ADMIXTURES CERTIFIED BY MANUFACTURER TO BE COMPATIBLE WITH OTHER ADMIXTURES AND TO CONTAIN NOT MORE THAN 0.1 PERCENT WATER-SOLUBLE CHLORIDE IONS BY MASS OF CEMENTITIOUS MATERIAL.
 - E. WATER: POTABLE AND COMPLYING WITH ASTM C94.
5. **CURING MATERIALS**
 - A. ABSORPTIVE COVER: AASHTO M 182, CLASS 3, BURLAP CLOTH.
 - B. MOISTURE-RETAINING COVER: ASTM C 171, POLYETHYLENE FILM OR WHITE BURLAP-POLYETHYLENE SHEET.

- C. WATER: POTABLE.
- D. EVAPORATION RETARDER: WATERBORNE, MONOMOLECULAR, FILM FORMING, MANUFACTURED FOR APPLICATION TO FRESH CONCRETE.
- E. WHITE, WATERBORNE, MEMBRANE-FORMING CURING COMPOUND: ASTM C 309, TYPE 2, CLASS B, DISSIPATING.
- 6. **RELATED MATERIALS**
 - A. JOINT FILLERS:
 - 1. CLEAR HEART REDWOOD IN ACCORDANCE WITH LADOTD STANDARD SPECIFICATION SECTION 1005.01.2.
 - B. COLD-APPLIED JOINT SEALANTS:
 - 1. TYPE NS SILICONE SEALANT FOR CONCRETE: SINGLE-COMPONENT, LOW-MODULUS, NEUTRAL-CURING, NON-SAG SILICONE SEALANT COMPLYING WITH ASTM D5893 FOR TYPE NS.
 - a. PRODUCT SHALL BE RESTRICTED TO SUPPLIERS AND SOURCES PROVIDED ON LA DOTD QPL 42.
 - 2. TYPE SL SILICONE SEALANT FOR CONCRETE: SINGLE-COMPONENT, LOW-MODULUS, NEUTRAL-CURING, SELF-LEVELING SILICONE SEALANT COMPLYING WITH ASTM D5893 FOR TYPE SL.
 - a. PRODUCT SHALL BE RESTRICTED TO SUPPLIERS AND SOURCES PROVIDED ON LA DOTD QPL 42.
 - C. JOINT-SEALANT BACKER MATERIALS:
 - 1. ROUND BACKER RODS FOR COLD-APPLIED SEALANTS: ASTM D5249, TYPE 3, OF DIAMETER AND DENSITY REQUIRE TO CONTROL SEALANT DEPTHS AND PREVENT BOTTOM-SIDE ADHESION OF SEALANT.
 - D. BONDING AGENT: ASTM C 1059/C 1059M, TYPE II, NON-REDISPERSIBLE, ACRYLIC EMULSION OR STYRENE BUTADIENE.
- 7. **CONCRETE MIXTURES**
 - A. PREPARE DESIGN MIXTURES, PROPORTIONED ACCORDING TO ACI 301, FOR EACH TYPE, STRENGTH, AND THICKNESS OF NORMAL-WEIGHT CONCRETE, AND AS DETERMINED BY EITHER LABORATORY TRIAL MIXTURES OR FIELD EXPERIENCE.
 - B. CEMENTITIOUS MATERIALS: LIMIT PERCENTAGE, BY WEIGHT, OF CEMENTITIOUS MATERIALS OTHER THAN PORTLAND CEMENT IN CONCRETE AS FOLLOWS:
 - 1. FLY ASH OR POZZOLAN: 20 PERCENT.
 - C. ADD AIR-ENTRAINING ADMIXTURE AT MANUFACTURER'S PRESCRIBED RATE TO RESULT IN NORMAL-WEIGHT CONCRETE AT POINT OF PLACEMENT HAVING AN AIR CONTENT AS FOLLOWS:
 - 1. AIR CONTENT: 4.5 PERCENT PLUS OR MINUS 1-1/2 PERCENT.
 - D. CHEMICAL ADMIXTURES: USE ADMIXTURES ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS.
 - 1. USE WATER-REDUCING ADMIXTURE IN CONCRETE AS REQUIRED FOR PLACEMENT AND WORKABILITY.
 - 2. USE WATER-REDUCING AND RETARDING ADMIXTURE WHEN REQUIRED BY HIGH TEMPERATURES, LOW HUMIDITY, OR OTHER ADVERSE PLACEMENT CONDITIONS.
 - E. CONCRETE MIXTURES: NORMAL-WEIGHT CONCRETE.
 - 1. COMPRESSIVE STRENGTH (28 DAYS):
 - a. PAVEMENT AND BARRIER CURBS: 4000 PSI.
 - b. SIDEWALKS: 3000PSI.

2. MAXIMUM W/C RATIO AT POINT OF PLACEMENT: 0.45.
3. SLUMP LIMIT: 4 INCHES, PLUS OR MINUS 1 INCH.
 - a. SLUMP LIMIT MAY BE ADJUSTED IF WATER-REDUCING ADMIXTURES ARE USED.
8. **CONCRETE MIXING**
 - A. READY-MIXED CONCRETE: MEASURE, BATCH, AND MIX CONCRETE MATERIALS AND CONCRETE ACCORDING TO ASTM C94. FURNISH BATCH CERTIFICATES FOR EACH BATCH DISCHARGED AND USED IN THE WORK.
9. **EXAMINATION**
 - A. PROOF-ROLL PREPARED SUBBASE SURFACE BELOW AREAS OF PROPOSED CONCRETE PAVEMENTS IN ACCORDANCE WITH EARTH MOVING SPECIFICATIONS TO IDENTIFY SOFT POCKETS AND AREAS OF EXCESS YIELDING.
10. **JOINTS**
 - A. GENERAL: FORM CONSTRUCTION, ISOLATION, AND CONTRACTION JOINTS AND TOOL EDGES TRUE TO LINE, WITH FACES PERPENDICULAR TO SURFACE PLANE OF CONCRETE. CONSTRUCT TRANSVERSE JOINTS AT RIGHT ANGLES TO CENTERLINE UNLESS OTHERWISE INDICATED.
 - B. CONSTRUCTION JOINTS: SET CONSTRUCTION JOINTS AT SIDE AND END TERMINATIONS OF PAVING AND AT LOCATIONS WHERE PAVING OPERATIONS ARE STOPPED FOR MORE THAN ONE-HALF HOUR UNLESS PAVING TERMINATES AT ISOLATION JOINTS.
 - C. ISOLATION JOINTS: FORM ISOLATION JOINTS OF PREFORMED JOINT-FILLER STRIPS ABUTTING CONCRETE CURBS, CATCH BASINS, MANHOLES, INLETS, STRUCTURES, OTHER FIXED OBJECTS, AND WHERE INDICATED.
 - D. CONTRACTION JOINTS: FORM WEAKENED-PLANE CONTRACTION JOINTS, SECTIONING CONCRETE INTO AREAS AS INDICATED. CONSTRUCT CONTRACTION JOINTS FOR A DEPTH EQUAL TO AT LEAST ONE-FOURTH OF THE CONCRETE THICKNESS.
 - E. EDGING: AFTER INITIAL FLOATING, TOOL EDGES OF PAVING, GUTTERS, CURBS, AND JOINTS IN CONCRETE WITH AN EDGING TOOL TO A 1/4-INCH RADIUS. REPEAT TOOLING OF EDGES AFTER APPLYING SURFACE FINISHES. ELIMINATE EDGING-TOOL MARKS ON CONCRETE SURFACES.
11. **CONCRETE PLACEMENT**
 - A. MOISTEN SUBBASE TO PROVIDE A UNIFORM DAMPENED CONDITION AT TIME CONCRETE IS PLACED. DO NOT PLACE CONCRETE AROUND MANHOLES OR OTHER STRUCTURES UNTIL THEY ARE AT REQUIRED FINISH ELEVATION AND ALIGNMENT.
 - B. COMPLY WITH ACI 301 REQUIREMENTS FOR MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE.
 - C. DEPOSIT AND SPREAD CONCRETE IN A CONTINUOUS OPERATION BETWEEN TRANSVERSE JOINTS. DO NOT PUSH OR DRAG CONCRETE INTO PLACE OR USE VIBRATORS TO MOVE CONCRETE INTO PLACE.
 - D. SCREED PAVING SURFACE WITH A STRAIGHTEDGE AND STRIKE OFF.
 - E. COMMENCE INITIAL FLOATING USING BULL FLOATS OR DARBIES TO IMPART AN OPEN-TEXTURED AND UNIFORM SURFACE PLANE BEFORE EXCESS MOISTURE OR BLEEDWATER APPEARS ON THE SURFACE. DO NOT FURTHER DISTURB CONCRETE SURFACES BEFORE BEGINNING FINISHING OPERATIONS OR SPREADING SURFACE TREATMENTS.

12. FLOAT FINISHING

- A. GENERAL: DO NOT ADD WATER TO CONCRETE SURFACES DURING FINISHING OPERATIONS.
- B. FLOAT FINISH: BEGIN THE SECOND FLOATING OPERATION WHEN BLEEDWATER SHEEN HAS DISAPPEARED AND CONCRETE SURFACE HAS STIFFENED SUFFICIENTLY TO PERMIT OPERATIONS. FLOAT SURFACE WITH POWER-DRIVEN FLOATS OR BY HAND FLOATING IF AREA IS SMALL OR INACCESSIBLE TO POWER UNITS. FINISH SURFACES TO TRUE PLANES. CUT DOWN HIGH SPOTS AND FILL LOW SPOTS. REFLOAT SURFACE IMMEDIATELY TO UNIFORM GRANULAR TEXTURE.
 - 1. MEDIUM-TO-FINE-TEXTURED BROOM FINISH: DRAW A SOFT-BRISTLE BROOM ACROSS FLOAT-FINISHED CONCRETE SURFACE, PERPENDICULAR TO LINE OF TRAFFIC, TO PROVIDE A UNIFORM, FINE-LINE TEXTURE.

13. CONCRETE PROTECTION AND CURING

- A. GENERAL: PROTECT FRESHLY PLACED CONCRETE FROM PREMATURE DRYING AND EXCESSIVE COLD OR HOT TEMPERATURES.
- B. COMPLY WITH ACI 306.1 FOR COLD-WEATHER PROTECTION.
- C. EVAPORATION RETARDER: APPLY EVAPORATION RETARDER TO CONCRETE SURFACES IF HOT, DRY, OR WINDY CONDITIONS CAUSE MOISTURE LOSS APPROACHING 0.2 LB/SQ. FT. X H BEFORE AND DURING FINISHING OPERATIONS. APPLY ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS AFTER PLACING, SCREEDING, AND BULL FLOATING OR DARBYING CONCRETE BUT BEFORE FLOAT FINISHING.
- D. BEGIN CURING AFTER FINISHING CONCRETE BUT NOT BEFORE FREE WATER HAS DISAPPEARED FROM CONCRETE SURFACE.
- E. CURING METHODS: CURE CONCRETE BY MOISTURE CURING, MOISTURE-RETAINING-COVER CURING, CURING COMPOUND, OR A COMBINATION OF THESE METHODS.

14. PAVING TOLERANCES

- A. COMPLY WITH TOLERANCES IN ACI 117 AND AS FOLLOWS:
 - 1. ELEVATION: 1/4 INCH.
 - a. MAXIMUM VARIATIONS IN SURFACE TOLERANCE SHALL NOT EXCEED 1/4 INCH IN 10 FEET.
 - 2. THICKNESS: PLUS 3/8 INCH, MINUS 1/4 INCH.
 - 3. JOINT SPACING: 3 INCHES.
 - 4. CONTRACTION JOINT DEPTH: PLUS 1/4 INCH, NO MINUS.
 - 5. JOINT WIDTH: PLUS 1/8 INCH, NO MINUS.

15. FIELD QUALITY CONTROL

- A. TESTING AGENCY: OWNER WILL ENGAGE A QUALIFIED TESTING AGENCY TO PERFORM TESTS AND INSPECTIONS.
- B. TESTING SERVICES: TESTING AND INSPECTING OF COMPOSITE SAMPLES OF FRESH CONCRETE OBTAINED ACCORDING TO ASTM C172 SHALL BE PERFORMED ACCORDING TO THE FOLLOWING REQUIREMENTS:
 - 1. TESTING FREQUENCY: OBTAIN AT LEAST ONE COMPOSITE SAMPLE FOR EACH 100 CU. YD. OR FRACTION THEREOF OF EACH CONCRETE MIXTURE PLACED EACH DAY.

- a. WHEN FREQUENCY OF TESTING WILL PROVIDE FEWER THAN FIVE COMPRESSIVE-STRENGTH TESTS FOR EACH CONCRETE MIXTURE, TESTING SHALL BE CONDUCTED FROM AT LEAST FIVE RANDOMLY SELECTED BATCHES OR FROM EACH BATCH IF FEWER THAN FIVE ARE USED.
2. SLUMP: ASTM C143; ONE TEST AT POINT OF PLACEMENT FOR EACH COMPOSITE SAMPLE, BUT NOT LESS THAN ONE TEST FOR EACH DAY'S POUR OF EACH CONCRETE MIXTURE. PERFORM ADDITIONAL TESTS WHEN CONCRETE CONSISTENCY APPEARS TO CHANGE.
3. AIR CONTENT: ASTM C231, PRESSURE METHOD; ONE TEST FOR EACH COMPOSITE SAMPLE, BUT NOT LESS THAN ONE TEST FOR EACH DAY'S POUR OF EACH CONCRETE MIXTURE.
4. CONCRETE TEMPERATURE: ASTM C1064; ONE TEST HOURLY WHEN AIR TEMPERATURE IS 40 DEG F (4.4 DEG C) AND BELOW AND WHEN IT IS 80 DEG F (27 DEG C) AND ABOVE, AND ONE TEST FOR EACH COMPOSITE SAMPLE.
5. COMPRESSION TEST SPECIMENS: ASTM C31; CAST AND LABORATORY CURE ONE SET OF FOUR STANDARD CYLINDER SPECIMENS FOR EACH COMPOSITE SAMPLE. ONE SPECIMEN SHALL BE RETAINED FOR LATER TESTING, IF REQUIRED.
6. COMPRESSIVE-STRENGTH TESTS: ASTM C39; TEST ONE SPECIMEN AT SEVEN DAYS AND TWO SPECIMENS AT 28 DAYS.
 - a. A COMPRESSIVE-STRENGTH TEST SHALL BE THE AVERAGE COMPRESSIVE STRENGTH FROM TWO SPECIMENS OBTAINED FROM SAME COMPOSITE SAMPLE AND TESTED AT 28 DAYS.
- C. STRENGTH OF EACH CONCRETE MIXTURE WILL BE SATISFACTORY IF AVERAGE OF ANY THREE CONSECUTIVE COMPRESSIVE-STRENGTH TESTS EQUALS OR EXCEEDS SPECIFIED COMPRESSIVE STRENGTH AND NO INDIVIDUAL COMPRESSIVE-STRENGTH TEST VALUE FALLS BELOW SPECIFIED COMPRESSIVE STRENGTH BY MORE THAN 500 PSI.
- D. TEST RESULTS SHALL BE REPORTED IN WRITING TO ENGINEER, CONCRETE MANUFACTURER, AND CONTRACTOR WITHIN 48 HOURS OF TESTING. REPORTS OF COMPRESSIVE-STRENGTH TESTS SHALL CONTAIN PROJECT IDENTIFICATION NAME AND NUMBER, DATE OF CONCRETE PLACEMENT, NAME OF CONCRETE TESTING AND INSPECTING AGENCY, LOCATION OF CONCRETE BATCH IN WORK, DESIGN COMPRESSIVE STRENGTH AT 28 DAYS, CONCRETE MIXTURE PROPORTIONS AND MATERIALS, COMPRESSIVE BREAKING STRENGTH, AND TYPE OF BREAK FOR BOTH 7- AND 28-DAY TESTS.
- E. NONDESTRUCTIVE TESTING: IMPACT HAMMER, SONOSCOPE, OR OTHER NONDESTRUCTIVE DEVICE MAY BE PERMITTED BY ENGINEER BUT WILL NOT BE USED AS SOLE BASIS FOR APPROVAL OR REJECTION OF CONCRETE.
- F. ADDITIONAL TESTS: TESTING AND INSPECTING AGENCY SHALL MAKE ADDITIONAL TESTS OF CONCRETE WHEN TEST RESULTS INDICATE THAT SLUMP, AIR ENTRAINMENT, COMPRESSIVE STRENGTHS, OR OTHER REQUIREMENTS HAVE NOT BEEN MET, AS DIRECTED BY ENGINEER.
- G. CONCRETE PAVING WILL BE CONSIDERED DEFECTIVE IF IT DOES NOT PASS TESTS AND INSPECTIONS.
 1. CONCRETE PAVING THAT HAS BEEN DETERMINED TO BE DEFECTIVE SHALL BE REPLACED AT NO ADDITIONAL COST TO THE OWNER.
- H. ADDITIONAL TESTING AND INSPECTING, AT CONTRACTOR'S EXPENSE, WILL BE PERFORMED TO DETERMINE COMPLIANCE OF REPLACED OR ADDITIONAL WORK WITH SPECIFIED REQUIREMENTS.
- I. PREPARE TEST AND INSPECTION REPORTS.

16. REPAIR AND PROTECTION

- A. REMOVE AND REPLACE CONCRETE PAVING THAT IS BROKEN, DAMAGED, OR DEFECTIVE OR THAT DOES NOT COMPLY WITH REQUIREMENTS IN THIS SECTION. REMOVE WORK IN COMPLETE SECTIONS FROM JOINT TO JOINT UNLESS OTHERWISE APPROVED BY ARCHITECT.
- B. PROTECT CONCRETE PAVING FROM DAMAGE. EXCLUDE TRAFFIC FROM PAVING FOR AT LEAST 14 DAYS AFTER PLACEMENT. WHEN CONSTRUCTION TRAFFIC IS PERMITTED, MAINTAIN PAVING AS CLEAN AS POSSIBLE BY REMOVING SURFACE STAINS AND SPILLAGE OF MATERIALS AS THEY OCCUR.
- C. MAINTAIN CONCRETE PAVING FREE OF STAINS, DISCOLORATION, DIRT, AND OTHER FOREIGN MATERIAL. SWEEP PAVING NOT MORE THAN TWO DAYS BEFORE DATE SCHEDULED FOR SUBSTANTIAL COMPLETION INSPECTIONS.

END OF SECTION

SECTION 32 31 19
DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative steel fences.
- B. Automatic gate operators.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- C. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).
- D. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2002 (Reapproved 2017).
- E. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings; 2013 (Reapproved 2018).
- F. ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008, with Editorial Revision (2017).
- G. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2022.
- H. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2019).
- I. ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test; 2022.
- J. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction; 2020.
- K. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016.
- L. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing; 2018.
- M. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- P. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- Q. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. Product Data: Submit 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. Design Calculations: For high wind load areas, provide calculations for fence panels and accessory selection as well as line post spacing and foundation details. See CLFMI WLG 2445 for line post and spacing guidance.
- C. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- D. Samples: Submit two samples of fence panels, slat infill, 12 inch by 12 inch in size illustrating construction and colored finish.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Manufacturer's Warranty.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years experience.

- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.08 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Decorative Metal Fences and Gates:
- B. Automatic Gate Operators:

2.02 FENCES

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
 - 1. Capable of resisting vertical load, horizontal load and infill performance requirements for fence categories defined in ASTM F2408.
- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils, minimum.
 - 2. Color: As selected by Architect from manufacturer's standard range.
 - 3. Coating Performance: Comply with general requirements of ASTM F2408.
 - a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
 - b. Corrosion Resistance: ASTM B117, ASTM D714 and ASTM D1654; 1/8 inch coating loss or medium No.8 blisters after 1,500 hours.
 - c. Impact Resistance: ASTM D2794; 60 inch pounds.
 - d. Weathering Resistance: ASTM D523, ASTM D822/D822M and ASTM D2244; less than 60 percent loss of gloss.
- C. Steel: ASTM A653/A653M; tensile strength 45,000 psi, minimum.

1. Hot-dip galvanized; ASTM A653/A653M, G60.
 2. 62 percent recycled steel, minimum.
- D. Hinges: Finished to match fence components.
1. Brackets: Round.
 2. Mounting: Center.
 3. Closing: Manual.
- E. Latches: Finished to match fence components.
1. Brackets: Round.
 2. Locking: Mechanical.

2.03 MECHANICALLY FASTENED STEEL FENCE

- A. Provide fence meeting requirements for Industrial class as defined by ASTM F2408.
- B. Fence Panels: Mechanically fastened with internal reinforcement and tamperproof fasteners; 7 feet high by 8 feet long.
1. Panel Style: Two rail.
 2. Panel Strength: Capable of supporting 600 pound load applied at midspan without deflection.
 3. Attach panels to posts with manufacturer's standard panel brackets.
- C. Posts: Steel tube.
1. Size: 4 inches square by 12 gauge, 0.1094 inch, with manufacturer's standard cap.
 2. Post Cap: Flush plate.
- D. Rails: Manufacturer's standard, double-wall steel channel; 1-3/4 inch square by 14 gauge, 0.0747 inch with pre-punched picket holes.
1. Picket Retaining Rods: 1/8 inch galvanized steel.
 2. Picket-to-Rail Intersection Seals: PVC grommets.
- E. Pickets: Steel tube.
1. Spacing: 4.175 inch on center.
 2. Size: 1 inch square by 14 gauge, 0.0747 inch
 3. Style: Pickets with finial extend above top rail.

4. Finial: Spear point.

F. Flexibility: Capable of following variable slope of up to 1:4.

2.04 AUTOMATIC GATE OPERATORS

A. Sliding Gates: Prewired, pedestal-mounted gate operator for horizontal sliding gates, per ASTM F2200 and UL 325.

1. Operating type: Drive belt.

2. Control Functions: Open, Pause, Close.

3. Maximum Open/Close Time: 10 seconds.

4. Access: Card.

5. Maximum gate weight: 500 pounds (187 kilograms).

6. Horsepower Rating: Suitable for connected load.

7. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.

8. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

a. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:

2.05 ACCESSORIES

A. Keypad Mounting Supports: Where not factory installed, provide mounting supports for keypad installation.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

- B. Set fence posts in accordance with the manufacturer recommended spacing.
- C. When cutting rails immediately seal the exposed surfaces by:
 - 1. Removing metal shavings from cut area.
 - 2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.
 - 3. Apply two coats of custom finish spray paint matching fence color.
 - 4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.
- D. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
 - 1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.
 - 2. Identify the necessary hardware required for the application on the manufacturer's gate drawings.
 - 3. Provide gate hardware by the manufacturer of the gate and install in compliance with manufacturer's recommendations.
- E. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum Distance from Property Line: 6 inches.

3.05 FIELD QUALITY CONTROL

- A. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- B. Post Settings: Randomly inspect three locations against design for:
 - 1. Hole diameter.
 - 2. Hole depth.
 - 3. Hole spacing.
- C. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.

- D. Gates: Inspect for level, plumb, and alignment.
- E. Workmanship: Verify neat installation free of defects.

3.06 CLEANING

- A. Leave immediate work area neat at end of work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.

3.08 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 32 31 19

SECTION 32 84 00
PLANTING IRRIGATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Piping.
 - 2. Manual valves.
 - 3. Pressure-reducing valves.
 - 4. Automatic control valves.
 - 5. Miscellaneous piping specialties.
 - 6. Quick couplers.
 - 7. Drip irrigation specialties.
 - 8. Controllers.
 - 9. Boxes for automatic control valves.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design, calculate and test an irrigation system to suit locally available materials, project site conditions, the needs of the plants and the Architect's review. Irrigation design includes but is not limited to selecting materials and compatible jointing systems, calculating friction losses, sizing pipes and fittings and documenting location of system components.
- B. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- C. Location of Irrigation Areas: Maintain 100 percent irrigation coverage of areas indicated.

1.04 SUBMITTALS

- A. Shop Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.

- B. Product Data: For each type of product indicated.
- C. Qualification Data: For qualified Installer.
- D. Zoning Chart: Show each irrigation zone and its control valve.
- E. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For controllers and automatic control valves to include in operation and maintenance manuals.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Wrenches and other tools required for maintenance of equipment.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers that include a certified irrigation designer qualified by The Irrigation Association or other registered irrigation consultant. Submit qualifications for approval by Architect.
- 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.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- C. All drip tubing and irrigation control valves shall be suitably stored and protected until installed and placed in operation.

1.07 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than two (2) days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Architect's written permission.

PART 2 PRODUCTS

2.01 DRIP IRRIGATION COMPONENTS

- A. All drip irrigation system components shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The components shall be designed, manufactured, and installed in accordance with ASTM and AWWA methods and shall comply with these Specifications.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Rain Bird, 970 West Sierra Madre Ave., Azusa, CA 91702, Phone: (800) 724-6247, Website: www.rainbird.com.

2.02 CONVENTIONAL IRRIGATION COMPONENTS

- A. All conventional irrigation system components such as valves and sprinkler heads shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The components shall be designed, manufactured, and installed in accordance with ASTM and AWWA methods and shall comply with these Specifications.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Rain Bird, 970 West Sierra Madre Ave., Azusa, CA 91702, Phone: (800) 724-6247, Website: www.rainbird.com.

2.03 CONTROLLERS

- A. Controller Stations for Automatic Control Valves: ESP-TM2 Smart Modular Control System.
 - 1. Controller shall be equipped with weather sensing capabilities.
 - 2. Controller shall be equipped with flow sensor.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Rain Bird, 970 West Sierra Madre Ave., Azusa, CA 91702, Phone: (800) 724-6247, Website: www.rainbird.com.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

3.02 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.03 PIPING INSTALLATION

- A. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- B. Install piping free of sags and bends.
- C. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- D. Install fittings for changes in direction and branch connections.
- E. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- F. Install ductile-iron piping according to AWWA C600.
- G. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- H. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install above ground or in control-valve boxes.
- I. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- J. Install piping in sleeves under parking lots, roadways, and sidewalks.

3.04 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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. Flat Latex: One coat over primer/sealer: MPI INT 9.1A.
 - 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.

- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads
- E. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- F. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- G. PVC Piping Solvent-Cemented 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. 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.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.05 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries unless otherwise indicated.

3.06 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
- C. Install valves and PVC pipe with restrained, gasketed joints.
- D. Aboveground Valves: Install as components of connected piping system.
- E. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- F. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.07 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on wall.

1. Place and secure anchorage devices. Use 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.
- B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
1. Place and secure anchorage devices. Use 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.
- C. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.08 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.09 DRIP IRRIGATION

- A. Coordinate installation of zone piping and placement of dripline tubing with placement of topsoil and installation of trees, shrubs, and ground cover.
- B. Install 1 solid PVC zone piping a minimum of 12-inches below finished grade. Grade and slope shall be uniform from low point to high points with air/vacuum relief valves installed at high points within an irrigation zone.
- C. Install a flush valve and box at the end of each irrigation zone to facilitate manual flushing.
- D. Drip tubing shall be uniformly spaced at a minimum of 18-inch to provide uniform wetting at a depth of 4-6 inches below finish grade.
- E. Place air/vacuum relief valve(s) at the highest point(s) of each zone. Connect the air/vacuum relief valve to all dripline laterals within the elevated area with an air/vacuum relief lateral.
- F. Place dripline no further than four inches from the edge of the areas to be irrigated.
- G. Uniformly space drip tubing such that maximum spacing between drip tubing is 18 inches.
- H. Thoroughly flush and pressure test the drip tubing to a minimum of 10 psi prior to covering tubing to identify leaks in fittings, splices, and compression fittings. Repair all leaks.

- I. Exercise extreme care when placing plants so as not to damage or cut any drip tubing or zone piping. Repair or replace cut or damaged sections as may be warranted.
- J. Install properly sized control wiring in minimum ¾-inch PVC conduit to each control valve box for each irrigation zone. Bury conduit a minimum of 12-inches below finish grade.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. D Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

3.11 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.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Test and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Any irrigation product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.12 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that controllers are installed and connected according to the Contract Documents.
 - 3. Verify that electrical wiring installation complies with manufacturer's submittal

3.13 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each circuit.
- C. Adjust devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

3.14 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.15 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

END OF SECTION 32 84 00

SECTION 32 92 00
TURFGRASSES

PAR 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Sodding.
 - 2. Turf Renovation.
- B. Related Sections:
 - 1. Division 32 Section "Planting".

1.03 DEFINITIONS

- A. Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- F. Planting Area: Areas to be planted.
- G. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.
- H. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
 - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
- B. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis of standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turfgrass during a calendar year. Submit before start of required maintenance periods.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
 - 1. Experience: Five (5) years' experience as a Landscape Horticulturalist as well as five (5) years experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Personnel Certifications: Installer's field supervisor shall have certification as a Landscape Horticulturalist licensed by the state.
 - 4. Pesticide Applicator: State licensed, commercial.
- B. Preinstallation Conference: Conduct conference at Project site or other location approved by Architect. Contractor to notify Architect of meeting time/location at least seven (7) days in advance.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new turf by field measurements before proceeding with turfgrass work.
- B. Planting Restrictions: Plant during the following period. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
 1. Planting Season: May 1st to September 1st.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.08 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of land-scape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods.
 1. Sodded Turf: The Contractor shall maintain sodded areas for twelve (12) months from the time of Substantial Completion.

PART 2 PRODUCTS

2.01 TURFGRASS SOD

- A. Turfgrass Sod: Approved, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod grown on sand substrate of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Bermuda Grass (*Cynodon dactylon*): See Plans.

2.02 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.02 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
 - 1. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 - 2. Spread planting soil to a depth of 6 inches to meet finish grades after light rolling and natural settlement. Do not spread if subgrade is frozen, muddy, or excessively wet.
- C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - 3. Spread pump sand to a depth of 2 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if subgrade is frozen, muddy, or excessively wet.
 - 4. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 - 5. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Use rolls of sod for large areas.
- C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across angle of slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
 - 3. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.
 - 4. Sodded areas are to be top dressed using coarse sand filling seam joints.

3.05 TURF RENOVATION

- A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
 - 3. The sod shall be of the same type and variety as the existing grass.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Water newly planted areas and keep moist until new turf is established.

3.06 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Turf Watering: Contractor shall irrigate as required to maintain vigorous and healthy turf growth. Overwatering or flooding shall not be allowed. The Contractor shall furnish any water to ensure adequate irrigation during maintenance period.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow Bermuda grass to a height of 1.0 to 2.0 inches.
- D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

3.07 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Landscape Architect:
1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
 2. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.08 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.09 CLEAN UP PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment-period.

END OF SECTION 32 92 00

SECTION 00 01 03
PLANTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Plants.
 - 2. Planting Soil.
 - 3. Mulch.
 - 4. Tree Stabilization.
 - 5. Slow-Release Watering Bags.
 - 6. Separation Fabric
 - 7. Drainage Plate
 - 8. Landscape Edging

1.03 DEFINITIONS

- A. Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- F. Planting Area: Areas to be planted.
- G. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

- H. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project
 - 3. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
 - 4. Soils: Include source of materials and photographs of each constituent material.
 - 5. Mulch.
 - 6. Tree Stabilization.
 - 7. Drainage Plate
- B. Product Submittals: For the following product:
 - 1. Soil: Submit a 1-gallon sample of each soil type after mixing to architect for approval.
 - 2. Material Test Reports: For Planting Soil.
- C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis of standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Warranty: Written warranty and maintenance procedures.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Pesticide Applicator, if applicable: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Architect of sources of planting materials seven days in advance of delivery to site.
- E. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed. Louisiana State University Division of Agriculture Cooperative Extension Service shall be the preferred testing facility.
- F. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three (3) representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.
 - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problems materials are present, provide additional recommendations for corrective action.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, rhizomes, corms, and tubers in a dry place at 60 to 65 deg F until planting.

- F. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 2. Do not remove container-grown stock from containers before time of planting.
 - 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of each service or utility.
 - 2. Do not proceed with interruption of services or utilities without Architect's written permission.
- C. Planting Restrictions: Plant during the following period unless temporary irrigation is installed, calibrated, operated, and maintained by the contractor for a period of 6 months from planting date.
 - 1. Planting Season: October 15 – April 1
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.08 WARRANTY

- A. Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Periods from Date of Substantial Completion of Project.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 - 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting seasons.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at the end of warranty period.
 - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.09 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
 - 1. Maintenance Period: The Contractor shall maintain for 12 months from the date of Substantial Completion.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance

immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: The Contractor shall maintain for 12 months from the date of Substantial Completion.

PART 2 PRODUCTS

2.01 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; with lichen, moss or other living substances growing on the bark; with cuts in the bark, whether healed or fresh; or with stem girdling roots will be rejected.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.02 INORGANIC SOIL AMENDMENTS

- A. Add necessary inorganic soil amendments as required by the soil test.

2.03 FERTILIZERS

- A. All fertilizer shall be a commercial balanced formula with at least 25% organic material and shall conform to applicable State fertilizer laws. It shall be a slow-release formula, "Osmocote", or equal and shall be used as specified by manufacturer. Fertilizer, unless otherwise specified, shall be delivered mixed as specified, in standard size, unopened containers, showing weight, analysis and name of manufacturer.

2.04 PLANTING SOILS

- A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones one half inch (1/2") or larger in any dimension and other

extraneous materials harmful to plant growth. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes. Test soil for pH levels after mixing. Soil source to be approved in writing by Landscape Architect.

1. Mix the following quantities of materials to produce Planting Soil:
 - a. 1/3 Existing Site Topsoil or Manufactured Topsoil.
 - b. 1/3 Black Bark Mulch.
 - c. 1/3 Clean Coarse Sand.
 - d. Weight of 8-8-8 Slow-Release Fertilizer per 1,000 SF: 8lbs.

2.05 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:
 1. Type: Pine needles in bales with long needles, not crushed or chopped.
 2. Depth: Three (3) inches.
 3. Cypress Mulch will not be accepted.
- B. Mulch must not be placed within three (3) inches of a tree trunk.
- C. The Contractor shall be responsible for the replacement of mulch during the one-year warranty and maintenance period.

2.06 TREE STABILIZATION SYSTEM

- A. Tree Stabilization Above ground
 1. Metal Stakes: Metal Stakes: 6' metal "T" post stakes, green. Or approved equivalent. Provide three (3) stakes per tree or as otherwise indicated in the Drawings.
 2. Guying straps: 3/4" wide "ArborTie" flat polypropylene strap with break strength of 900lbs (min). Color: dark green or black. As manufactured by, or approved equal
 - a. Manufacturer: Deep Root Partners, L.P., 81 Langton St., San Francisco, CA 94103, Phone: 800-458-7668, Website: www.deeproot.com or approved equal.
- B. Tree Stabilization Underground
 1. Rootball Fixing System: Below-grade stabilization system to secure each new planting; sized per manufacturer's recommendations unless otherwise indicated.
 2. Product: Plati-Mat Rootball Fixing System

- a. Manufacturer: Platipus Anchors Inc., 1902 Garner Station Blvd, Raleigh, NC 27603, Phone: (866) 752-8478, Website: www.platipus-anchors.com.

C. EXECUTION

2.07 SLOW RELEASE WATERING BAGS

- A. Product: Treegator (Original), Slow Release Watering Bag, 20 gallons.
- B. Manufacturer: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Treegator; 153 Mosswood Blvd; Youngsville NC, 27596; Tel: (866) 873-3428, Website: www.treegator.com

2.08 DRAINAGE PLATE

- A. Product: JDR 420
- B. Thickness: 0.5 inch
- C. Manufacturer: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. JDR Enterprises, Inc. 292 S. Main St., Suite 200 Alpharetta, GA 30009; Tel: (800) 843-7569, Website: www.j-drain.com

2.09 LANDSCAPE EDGING

- A. Edging: Standard Commercial Grade Steel Landscape Edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
 1. Edging Size: 1/4" thick x 4" deep
 2. Finish: Powdercoated steel.
 3. Stakes: 16" stake

PART 3 EXECUTION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.02 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 12 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Spread planting soil to the depth as indicated per drawings to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.

3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

3.05 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above finish grades.
 1. Use planting soil for backfill.
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets be-side the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.06 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.

- B. Do not apply pruning paint to wounds.

3.07 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.08 PLANTING AREA MULCHING

- A. Mulch surfaces of planting areas and other areas indicated only to a depth of 3”.
- B. Trees without the specified depth of mulch at the end of the Warranty and Maintenance period shall be rejected.

3.09 MAINTENANCE

- A. Trees and Shrubs: Contractor shall irrigate as required to maintain vigorous and healthy plant growth. Overwatering or flooding shall not be allowed. The Contractor shall furnish any water to ensure adequate irrigation.
- B. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- C. Stake Removal: At the end of the Warranty and Maintenance period, the Contractor shall be responsible for removing any above ground stakes from all trees planted under this contract.

3.10 CLEANUP PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion of Project remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.11 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 93 00

33 14 15
SITE WATER DISTRIBUTION

1. **GENERAL:** ALL WORK TO BE COORDINATED WITH THE S&WB.
2. **PIPING MATERIALS**
 - A. POTABLE-WATER PIPING AND COMPONENTS SHALL COMPLY WITH NSF 14, NSF 61, AND NSF 372. INCLUDE MARKING "NSF-PW" ON PIPING.
3. **PVC PIPE AND FITTINGS**
 - A. DOMESTIC SERVICE: PVC, SCHEDULE 40 PIPE: ASTM D1785.
 1. PVC, SCHEDULE 40 SOCKET FITTINGS: ASTM D2466.
 - B. DOMESTIC SERVICE: IPS PVC PRESSURE PIPE: ASTM D2241
4. **JOINING MATERIALS**
 - A. PLASTIC PIPE-FLANGE GASKET, BOLTS, AND NUTS: TYPE AND MATERIAL RECOMMENDED BY PIPING SYSTEM MANUFACTURER, UNLESS OTHERWISE INDICATED.
5. **GATE VALVES**
 - A. AWWA, CAST-IRON GATE VALVES:
 1. OS&Y, RISING-STEM, METAL-SEATED GATE VALVES:
 - a. DESCRIPTION: CAST- OR DUCTILE-IRON BODY AND BONNET, WITH CAST-IRON DOUBLE DISC, BRONZE DISC AND SEAT RINGS, AND BRONZE STEM.
 - 1) STANDARD: AWWA C500.
 - 2) MINIMUM PRESSURE RATING: 200 PSIG.
 - 3) END CONNECTIONS: FLANGED.
 2. OS&Y, RISING-STEM, RESILIENT-SEATED GATE VALVES:
 - a. DESCRIPTION: CAST- OR DUCTILE-IRON BODY AND BONNET, WITH BRONZE OR GRAY- OR DUCTILE-IRON GATE, RESILIENT SEATS, AND BRONZE STEM.
 - 1) STANDARD: AWWA C509.
 - 2) MINIMUM PRESSURE RATING: 200 PSIG.
 - 3) END CONNECTIONS: FLANGED.
6. **GATE VALVE ACCESSORIES AND SPECIALTIES**
 - A. VALVE BOXES: COMPLY WITH AWWA M44 FOR CAST-IRON VALVE BOXES. INCLUDE TOP SECTION, ADJUSTABLE EXTENSION OF LENGTH REQUIRED FOR DEPTH OF BURIAL OF VALVE, PLUG WITH LETTERING "WATER," AND BOTTOM SECTION WITH BASE THAT FITS OVER VALVE AND WITH A BARREL APPROXIMATELY 5 INCHES IN DIAMETER.
 1. OPERATING WRENCHES: STEEL, TEE-HANDLE WITH ONE POINTED END, STEM OF LENGTH TO OPERATE DEEPEST BURIED VALVE, AND SOCKET MATCHING VALVE OPERATING NUT.
7. **CHECK VALVES**
 - A. AWWA CHECK VALVES:
 1. DESCRIPTION: SWING-CHECK TYPE WITH RESILIENT SEAT. INCLUDE INTERIOR COATING ACCORDING TO AWWA C550 AND ENDS TO MATCH PIPING.
 - a. STANDARD: AWWA C508.
 - b. PRESSURE RATING: 175 PSIG.
8. **WATER METERS**
 - A. WATER METERS WILL BE FURNISHED BY WATER COMPANY.

SITE WATER DISTRIBUTION

9. BACKFLOW PREVENTERS

- A. BACKFLOW PREVENTER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF WATER METER UNLESS OTHERWISE SHOWN AND SHALL HAVE THERMAL PROTECTION AS LISTED IN THIS SECTION.
- B. REDUCED-PRESSURE-PRINCIPLE BACKFLOW PREVENTERS:
 - 1. STANDARD: ASSE 1013, AWWA C511.
 - 2. OPERATION: CONTINUOUS-PRESSURE APPLICATIONS.
 - 3. SIZE: SHALL MATCH SERVICE MAIN SIZE INDICATED ON DRAWINGS.
 - 4. PRESSURE LOSS AT DESIGN FLOW RATE: COORDINATE WITH PLUMBING ENGINEER FOR REQUIREMENTS.
 - 5. BODY: CAST IRON OR STEEL WITH INTERIOR LINING COMPLYING WITH AWWA C550 OR THAT IS FDA APPROVED.
 - 6. END CONNECTIONS: FLANGED.
 - 7. CONFIGURATION: DESIGNED FOR HORIZONTAL, STRAIGHT THROUGH FLOW.
 - 8. ACCESSORIES:
 - a. VALVES: BALL TYPE WITH THREADED ENDS ON INLET AND OUTLET OF NPS 2 AND SMALLER; OS&Y GATE TYPE WITH FLANGED ENDS ON INLET AND OUTLET OF NPS 2-1/2 AND LARGER.
 - b. AIR-GAP FITTING: ASME A112.1.2, MATCHING BACKFLOW PREVENTER CONNECTION.

10. PROTECTIVE ENCLOSURES

- A. FREEZE-PROTECTION ENCLOSURES:
 - 1. DESCRIPTION: INSULATED ENCLOSURE DESIGNED TO PROTECT ABOVEGROUND WATER PIPING, EQUIPMENT, OR SPECIALTIES FROM FREEZING AND DAMAGE, WITH HEAT SOURCE TO MAINTAIN MINIMUM INTERNAL TEMPERATURE OF 40 DEG F WHEN EXTERNAL TEMPERATURES REACH AS LOW AS 0 DEG F.
 - a. STANDARD: ASSE 1060.
 - b. CLASS I: FOR EQUIPMENT OR DEVICES OTHER THAN PRESSURE OR ATMOSPHERIC VACUUM BREAKERS.
 - c. CLASS I-V: FOR PRESSURE OR ATMOSPHERIC VACUUM BREAKER EQUIPMENT OR DEVICES. INCLUDE DRAIN OPENING IN HOUSING.
- B. ENCLOSURE BASES:
 - 1. DESCRIPTION: 4-INCH MINIMUM THICKNESS PRECAST CONCRETE, OF DIMENSIONS REQUIRED TO EXTEND AT LEAST 6 INCHES BEYOND EDGES OF ENCLOSURE HOUSINGS. INCLUDE OPENINGS FOR PIPING.

11. PIPING INSTALLATION

- A. WATER-MAIN CONNECTION: ARRANGE WITH UTILITY COMPANY FOR TAP OF SIZE AND IN LOCATION INDICATED IN WATER MAIN.
- B. INSTALL PVC, AWWA PIPE ACCORDING TO ASTM F 645 AND AWWA M23.
- C. BURY PIPING WITH DEPTH OF COVER OVER TOP AT LEAST 36 INCHES, WITH TOP AT LEAST 12 INCHES BELOW LEVEL OF MAXIMUM FROST PENETRATION.
- D. INSTALL PIPING BY TUNNELING OR JACKING, OR COMBINATION OF BOTH, UNDER STREETS AND OTHER OBSTRUCTIONS THAT CANNOT BE DISTURBED.
- E. EXTEND WATER-SERVICE PIPING AND CONNECT TO WATER-SUPPLY SOURCE AND BUILDING-WATER-PIPING SYSTEMS AT OUTSIDE FACE OF BUILDING WALL IN LOCATIONS AND PIPE SIZES INDICATED.

1. TERMINATE WATER-SERVICE PIPING AT BUILDING WALL UNTIL BUILDING-WATER-PIPING SYSTEMS ARE INSTALLED. TERMINATE PIPING WITH CAPS, PLUGS, OR FLANGES AS REQUIRED FOR PIPING MATERIAL. MAKE CONNECTIONS TO BUILDING-WATER-PIPING SYSTEMS WHEN THOSE SYSTEMS ARE INSTALLED.
- F. INSTALL UNDERGROUND PIPING WITH RESTRAINED JOINTS AT HORIZONTAL AND VERTICAL CHANGES IN DIRECTION. USE RESTRAINED-JOINT PIPING, THRUST BLOCKS, ANCHORS, TIE-RODS AND CLAMPS, AND OTHER SUPPORTS.
- 12. JOINT CONSTRUCTION**
 - A. MAKE PIPE JOINTS ACCORDING TO THE FOLLOWING:
 1. PVC PIPING GASKETED JOINTS: USE JOINING MATERIALS ACCORDING TO AWWA C900. CONSTRUCT JOINTS WITH ELASTOMERIC SEALS AND LUBRICANT ACCORDING TO ASTM D 2774 OR ASTM D 3139 AND PIPE MANUFACTURER'S WRITTEN INSTRUCTIONS.
 2. INSTALL DIELECTRIC FITTINGS IN PIPING AT CONNECTIONS OF DISSIMILAR METAL PIPING AND TUBING.
 - a. DIELECTRIC FITTINGS FOR NPS 2 AND SMALLER: USE DIELECTRIC NIPPLES.
 - b. DIELECTRIC FITTINGS FOR NPS 2-1/2 TO NPS 4: USE DIELECTRIC NIPPLES.
- 13. VALVE INSTALLATION**
 - A. AWWA GATE VALVES: COMPLY WITH AWWA C600 AND AWWA M44. INSTALL EACH UNDERGROUND VALVE WITH STEM POINTING UP AND WITH VALVE BOX.
 - B. AWWA VALVES OTHER THAN GATE VALVES: COMPLY WITH AWWA C600 AND AWWA M44.
 - C. UL/FMG, GATE VALVES: COMPLY WITH NFPA 24. INSTALL EACH UNDERGROUND VALVE AND VALVES IN VAULTS WITH STEM POINTING UP AND WITH VERTICAL CAST-IRON INDICATOR POST.
 - D. UL/FMG, VALVES OTHER THAN GATE VALVES: COMPLY WITH NFPA 24.
 - E. MSS VALVES: INSTALL AS COMPONENT OF CONNECTED PIPING SYSTEM.
 - F. CORPORATION VALVES AND CURB VALVES: INSTALL EACH UNDERGROUND CURB VALVE WITH HEAD POINTED UP AND WITH SERVICE BOX.
 - G. PRESSURE-REDUCING VALVES: INSTALL IN VAULT OR ABOVEGROUND BETWEEN SHUTOFF VALVES. INSTALL FULL-SIZE VALVED BYPASS.
 - H. RELIEF VALVES: COMPLY WITH AWWA C512. INSTALL ABOVEGROUND WITH SHUTOFF VALVE ON INLET.
- 14. BACKFLOW PREVENTER INSTALLATION**
 - A. INSTALL BACKFLOW PREVENTERS OF TYPE, SIZE, AND CAPACITY INDICATED. INCLUDE VALVES AND TEST COCKS. INSTALL ACCORDING TO REQUIREMENTS OF PLUMBING AND HEALTH DEPARTMENT AND AUTHORITIES HAVING JURISDICTION.
 - B. DO NOT INSTALL BACKFLOW PREVENTERS THAT HAVE RELIEF DRAIN IN VAULT OR IN OTHER SPACES SUBJECT TO FLOODING.
 - C. DO NOT INSTALL BYPASS PIPING AROUND BACKFLOW PREVENTERS.
- 15. PROTECTIVE ENCLOSURE INSTALLATION**
 - A. INSTALL CONCRETE BASE LEVEL AND WITH TOP APPROXIMATELY 2 INCHES ABOVE GRADE.
 - B. INSTALL PROTECTIVE ENCLOSURE OVER VALVES AND EQUIPMENT.
 - C. ANCHOR PROTECTIVE ENCLOSURE TO CONCRETE BASE.

16. CONNECTIONS

- A. CONNECT WATER-DISTRIBUTION PIPING TO UTILITY WATER MAIN EXTENSION.
- B. CONNECT WATER-DISTRIBUTION PIPING TO INTERIOR DOMESTIC WATER PIPING.

17. FIELD QUALITY CONTROL

- A. PIPING TESTS: CONDUCT PIPING TESTS BEFORE JOINTS ARE COVERED AND AFTER CONCRETE THRUST BLOCKS HAVE HARDENED SUFFICIENTLY. FILL PIPELINE 24 HOURS BEFORE TESTING AND APPLY TEST PRESSURE TO STABILIZE SYSTEM. USE ONLY POTABLE WATER.
- B. HYDROSTATIC TESTS: TEST AT NOT LESS THAN ONE-AND-ONE-HALF TIMES WORKING PRESSURE FOR TWO HOURS.
 - 1. INCREASE PRESSURE IN 50-PSIG INCREMENTS AND INSPECT EACH JOINT BETWEEN INCREMENTS. HOLD AT TEST PRESSURE FOR 1 HOUR; DECREASE TO 0 PSIG. SLOWLY INCREASE AGAIN TO TEST PRESSURE AND HOLD FOR 1 MORE HOUR. MAXIMUM ALLOWABLE LEAKAGE IS 2 QUARTS PER HOUR PER 100 JOINTS. REMAKE LEAKING JOINTS WITH NEW MATERIALS AND REPEAT TEST UNTIL LEAKAGE IS WITHIN ALLOWED LIMITS.
- C. BACKFLOW PREVENTERS SHALL BE TESTED IN ACCORDANCE WITH INTERNATIONAL PLUMBING CODE SECTION 312.10 AND ALL REFERENCED STANDARDS.
- D. PREPARE REPORTS OF TESTING ACTIVITIES.

18. IDENTIFICATION

- A. INSTALL CONTINUOUS UNDERGROUND DETECTABLE WARNING TAPE DURING BACKFILLING OF TRENCH FOR UNDERGROUND WATER-DISTRIBUTION PIPING. LOCATE BELOW FINISHED GRADE, DIRECTLY OVER PIPING. UNDERGROUND WARNING TAPES ARE SPECIFIED IN EARTH MOVING SPECIFICATION.
- B. PERMANENTLY ATTACH EQUIPMENT NAMEPLATE OR MARKER INDICATING PLASTIC WATER-SERVICE PIPING, ON MAIN ELECTRICAL METER PANEL.

19. CLEANING

- A. CLEAN AND DISINFECT WATER-DISTRIBUTION PIPING AS FOLLOWS:
 - 1. PURGE NEW WATER-DISTRIBUTION PIPING SYSTEMS AND PARTS OF EXISTING SYSTEMS THAT HAVE BEEN ALTERED, EXTENDED, OR REPAIRED BEFORE USE.
 - 2. USE PURGING AND DISINFECTING PROCEDURE PRESCRIBED BY AUTHORITIES HAVING JURISDICTION OR, IF METHOD IS NOT PRESCRIBED BY AUTHORITIES HAVING JURISDICTION, USE PROCEDURE DESCRIBED IN NFPA 24 FOR FLUSHING OF PIPING. FLUSH PIPING SYSTEM WITH CLEAN, POTABLE WATER UNTIL DIRTY WATER DOES NOT APPEAR AT POINTS OF OUTLET.
 - 3. USE PURGING AND DISINFECTING PROCEDURE PRESCRIBED BY AUTHORITIES HAVING JURISDICTION OR, IF METHOD IS NOT PRESCRIBED BY AUTHORITIES HAVING JURISDICTION, USE PROCEDURE DESCRIBED IN AWWA C651 OR DO AS FOLLOWS:
 - a. FILL SYSTEM OR PART OF SYSTEM WITH WATER/CHLORINE SOLUTION CONTAINING AT LEAST 50 PPM OF CHLORINE; ISOLATE AND ALLOW TO STAND FOR 24 HOURS.
 - b. DRAIN SYSTEM OR PART OF SYSTEM OF PREVIOUS SOLUTION AND REFILL WITH WATER/CHLORINE SOLUTION CONTAINING AT LEAST 200 PPM OF CHLORINE; ISOLATE AND ALLOW TO STAND FOR 3 HOURS.

- c. AFTER STANDING TIME, FLUSH SYSTEM WITH CLEAN, POTABLE WATER UNTIL NO CHLORINE REMAINS IN WATER COMING FROM SYSTEM.
 - d. SUBMIT WATER SAMPLES IN STERILE BOTTLES TO AUTHORITIES HAVING JURISDICTION. REPEAT PROCEDURE IF BIOLOGICAL EXAMINATION SHOWS EVIDENCE OF CONTAMINATION.
- B. PREPARE REPORTS OF PURGING AND DISINFECTING ACTIVITIES.

END OF SECTION

33 42 00
SITE STORM DRAINAGE

1. **RELATED DOCUMENTS**
 - A. ALL REFERENCES TO LADOTD SPECIFICATIONS ARE TO THE LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2016 EDITION.
2. **PLASTIC PIPE AND FITTINGS**
 - A. PVC GRAVITY SEWER PIPING:
 1. PIPE AND FITTINGS: ASTM F 949, PVC GRAVITY SEWER PIPE WITH BELL-AND-SPIGOT ENDS AND WITH INTEGRAL ASTM F 477, ELASTOMERIC SEALS FOR GASKETED JOINTS.
 - B. HIGH-DENSITY POLYETHYLENE (HDPE) GRAVITY PIPE AND FITTINGS
 1. PIPE AND FITTINGS: PIPE AND FITTINGS: ASTM F 2306, HDPE GRAVITY-FLOW STORM SEWER PIPE WITH INTEGRAL BELL-AND-SPIGOT ENDS AND WITH INTEGRAL ASTM F 477, ELASTOMERIC SEALS FOR GASKETED JOINTS.
 - C. POLYPROPYLENE (PP) GRAVITY PIPE AND FITTINGS
 1. PIPE AND FITTINGS: ASTM F 2881, HDPE GRAVITY-FLOW STORM SEWER PIPE WITH INTEGRAL BELL-AND-SPIGOT ENDS AND WITH INTEGRAL ASTM F 477, ELASTOMERIC SEALS FOR GASKETED JOINTS.
3. **CONCRETE PIPE AND FITTINGS**
 - A. REINFORCED-CONCRETE PIPE AND FITTINGS
 1. PROVIDE IN ACCORDANCE WITH LADOTD SPECIFICATION SECTION 701 AND ALL REFERENCED SECTIONS.
4. **CLEANOUTS**
 - A. CAST-IRON CLEANOUTS:
 1. DESCRIPTION: ASME A112.36.2M, ROUND, GRAY-IRON HOUSING WITH CLAMPING DEVICE AND ROUND, SECURED, SCORIATED, GRAY-IRON COVER. INCLUDE GRAY-IRON FERRULE WITH INSIDE CAULK OR SPIGOT CONNECTION AND COUNTERSUNK, TAPERED-THREAD, BRASS CLOSURE PLUG.
 2. TOP-LOADING CLASSIFICATION(S): MEDIUM AND EXTRA-HEAVY DUTY
 3. PIPE FITTING AND RISER TO CLEANOUT: PVC SCHEDULE 80 OR SDR 35 PLASTIC PIPE AND FITTINGS.
5. **PRE-CAST CONCRETE DRAINAGE STRUCTURES**
 - A. PROVIDE STRUCTURES IN ACCORDANCE WITH PLANS, CONFORMING TO DIMENSIONS, REINFORCEMENT, AND APPURTENANCES AS INDICATED.
 - B. STANDARD PRECAST CONCRETE DRAINAGE STRUCTURES:
 1. DESCRIPTION: ASTM C 913, PRECAST, REINFORCED CONCRETE, OF DEPTH INDICATED, WITH PROVISION FOR SEALANT JOINTS.
 2. BALLAST: INCREASE THICKNESS OF PRECAST CONCRETE SECTIONS OR ADD CONCRETE TO BASE SECTION AS REQUIRED TO PREVENT FLOTATION.
 3. JOINT SEALANT: ASTM C 990, BITUMEN OR BUTYL RUBBER.
 4. RESILIENT PIPE CONNECTORS: ASTM C 923, CAST OR FITTED INTO STRUCTURE WALLS, FOR EACH PIPE CONNECTION.
 - C. MANHOLE FRAMES AND COVERS:
 1. DESCRIPTION: FERROUS; 24-INCH INSIDE DIAMETER COVER. INCLUDE INDENTED TOP DESIGN WITH LETTERING CAST INTO COVER, USING WORDING EQUIVALENT TO "STORM SEWER."

2. MATERIAL: ASTM A 536, GRADE 60-40-18 DUCTILE IRON UNLESS OTHERWISE INDICATED.
- D. STORMWATER INLET FRAMES AND GRATES: INCLUDE FLAT GRATE WITH SHORT-SLOTTED DRAINAGE OPENINGS.
 1. SIZE: 24 BY 24 INCHES MINIMUM UNLESS OTHERWISE INDICATED.
 2. GRATE FREE AREA: APPROXIMATELY 50 PERCENT UNLESS OTHERWISE INDICATED.
 3. MATERIAL: ASTM A 536, GRADE 60-40-18, DUCTILE IRON DESIGNED FOR A-16 (AASHTO HS20-44), STRUCTURAL LOADING.
6. **CONCRETE**
 - A. GENERAL: CAST-IN-PLACE CONCRETE IN ACCORDANCE WITH ACI 318, ACI 350, AND THE FOLLOWING:
 1. CEMENT: ASTM C 150/C 150M, TYPE II.
 2. FINE AGGREGATE: ASTM C 33/C 33M, SAND.
 3. COARSE AGGREGATE: ASTM C 33/C 33M, CRUSHED GRAVEL.
 4. WATER: POTABLE.
 - B. PORTLAND CEMENT DESIGN MIX: 4000 PSI MINIMUM, WITH 0.45 MAXIMUM WATER/CEMENTITIOUS MATERIALS RATIO.
 1. REINFORCING FABRIC: ASTM A 1064/A 1064M, STEEL, WELDED WIRE FABRIC, PLAIN.
 2. REINFORCING BARS: ASTM A 615/A 615M, GRADE 60 (420 MPA) DEFORMED STEEL.
7. **PIPING INSTALLATION**
 - A. GENERAL LOCATIONS AND ARRANGEMENTS: DRAWING PLANS AND DETAILS INDICATE GENERAL LOCATION AND ARRANGEMENT OF UNDERGROUND STORM DRAINAGE PIPING. LOCATION AND ARRANGEMENT OF PIPING LAYOUT TAKE INTO ACCOUNT DESIGN CONSIDERATIONS. INSTALL PIPING AS INDICATED, TO EXTENT PRACTICAL. WHERE SPECIFIC INSTALLATION IS NOT INDICATED, FOLLOW PIPING MANUFACTURER'S WRITTEN INSTRUCTIONS.
 - B. INSTALL PIPING BEGINNING AT LOW POINT, TRUE TO GRADES AND ALIGNMENT INDICATED WITH UNBROKEN CONTINUITY OF INVERT. PLACE BELL ENDS OF PIPING FACING UPSTREAM. INSTALL GASKETS, SEALS, SLEEVES, AND COUPLINGS IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS FOR USE OF LUBRICANTS, CEMENTS, AND OTHER INSTALLATION REQUIREMENTS.
 - C. INSTALL MANHOLES FOR CHANGES IN DIRECTION UNLESS FITTINGS ARE INDICATED. USE FITTINGS FOR BRANCH CONNECTIONS UNLESS DIRECT TAP INTO EXISTING SEWER IS INDICATED.
 - D. INSTALL PROPER SIZE INCREASERS, REDUCERS, AND COUPLINGS WHERE DIFFERENT SIZES OR MATERIALS OF PIPES AND FITTINGS ARE CONNECTED. REDUCING SIZE OF PIPING IN DIRECTION OF FLOW IS PROHIBITED.
 - E. WHEN INSTALLING PIPE UNDER STREETS OR OTHER OBSTRUCTIONS THAT CANNOT BE DISTURBED, USE PIPE-JACKING PROCESS OF MICROTUNNELING.
 - F. STORMWATER RUNOFF SHALL NOT BE DIRECTED TOWARDS OR ALLOWED TO SHED INTO OPEN PIPE TRENCHES.
 - G. ADEQUATE GROUND COVER, AS DETERMINED BY MANUFACTURER, SHALL BE PROVIDED OVER INSTALLED PIPE TO PREVENT FLOTATION. IF ADEQUATE DEPTH CANNOT BE ACHIEVED, ANCHOR SYSTEM PER MANUFACTURER'S RECOMMENDATION SHALL BE PROVIDED AT NO ADDITIONAL COST TO OWNER.

- H. INSTALL GRAVITY-FLOW, NONPRESSURE DRAINAGE PIPING IN ACCORDANCE WITH THE FOLLOWING:
 - 1. INSTALL PIPING PITCHED DOWN IN DIRECTION OF FLOW.
 - 2. INSTALL PVC SEWER PIPING IN ACCORDANCE WITH ASTM D 2321 AND ASTM F 1668.
 - 3. INSTALL REINFORCED-CONCRETE SEWER PIPING IN ACCORDANCE WITH ASTM C 1479 AND ACPA'S "CONCRETE PIPE INSTALLATION MANUAL."
- 8. **PIPE JOINT CONSTRUCTION**
 - A. JOIN GRAVITY-FLOW, NONPRESSURE DRAINAGE PIPING IN ACCORDANCE WITH THE FOLLOWING:
 - 1. JOIN PVC CORRUGATED SEWER PIPING IN ACCORDANCE WITH ASTM D 2321 FOR ELASTOMERIC-SEAL JOINTS.
 - 2. JOIN PVC SEWER PIPING IN ACCORDANCE WITH ASTM D 2321 AND ASTM D 3034 FOR ELASTOMERIC-SEAL JOINTS OR ASTM D 3034 FOR ELASTOMERIC-GASKETED JOINTS.
 - 3. JOIN PERFORATED PVC SEWER PIPE AND FITTINGS ACCORDING TO ASTM D3212 WITH LOOSE BELL-AND-SPIGOT, PUSH-ON JOINTS.
 - 4. JOIN REINFORCED-CONCRETE SEWER PIPING IN ACCORDANCE WITH ACPA'S "CONCRETE PIPE INSTALLATION MANUAL" FOR RUBBER-GASKETED JOINTS.
 - 5. JOIN DISSIMILAR PIPE MATERIALS WITH NONPRESSURE-TYPE FLEXIBLE COUPLINGS.
 - B. SPECIAL PIPE COUPLINGS: JOIN PIPING MADE OF DIFFERENT MATERIALS AND DIMENSIONS WITH SPECIAL COUPLINGS MADE FOR THIS APPLICATION. USE COUPLINGS THAT ARE COMPATIBLE WITH AND FIT MATERIALS AND DIMENSIONS OF BOTH PIPES.
- 9. **CLEANOUT INSTALLATION**
 - A. INSTALL CLEANOUTS AND RISER EXTENSIONS FROM SEWER PIPES TO CLEANOUTS AT GRADE. USE PLASTIC PIPE FITTINGS IN SEWER PIPES AT BRANCHES FOR CLEANOUTS. INSTALL PIPING SO CLEANOUTS OPEN IN DIRECTION OF FLOW IN SEWER PIPE.
 - 1. USE MEDIUM DUTY TOP-LOADING CLASSIFICATION CLEANOUTS IN AREAS OF GRASS, LANDSCAPING, OR THAT WILL BE SUBJECT TO FOOT TRAFFIC ONLY.
 - 2. USE EXTRA-HEAVY DUTY TOP-LOADING CLASSIFICATION CLEANOUTS IN AREAS OF PROPOSED VEHICULAR USE.
 - B. SET CLEANOUT FRAMES AND COVERS IN EARTH IN CAST-IN-PLACE CONCRETE BLOCK, 18 BY 18 BY 12 INCHES DEEP. SET WITH TOPS 1 INCH ABOVE SURROUNDING EARTH GRADE.
 - C. SET CLEANOUT FRAMES AND COVERS IN CONCRETE PAVEMENT AND ROADS WITH TOPS FLUSH WITH PAVEMENT SURFACE.
- 10. **DRAINAGE STRUCTURE INSTALLATION**
 - A. GENERAL: INSTALL MANHOLES AND INLETS, COMPLETE WITH APPURTENANCES AND ACCESSORIES INDICATED.
 - B. INSTALL PRECAST DRAINAGE STRUCTURE SECTIONS WITH SEALANTS IN ACCORDANCE WITH ASTM C 891.
 - C. WHERE SPECIFIC DRAINAGE STRUCTURE CONSTRUCTION IS NOT INDICATED, FOLLOW MANHOLE MANUFACTURER'S WRITTEN INSTRUCTIONS.
 - D. PRECAST CONCRETE MANHOLES:

1. SET TOPS OF FRAMES AND COVERS FLUSH WITH FINISHED SURFACE OF MANHOLES THAT OCCUR IN PAVEMENTS. SET TOPS 3 INCHES ABOVE FINISHED SURFACE ELSEWHERE UNLESS OTHERWISE INDICATED.
- E. PRECAST CONCRETE INLETS:
 1. CONSTRUCT CATCH BASINS TO SIZES AND SHAPES INDICATED.
 2. SET FRAMES AND GRATES TO ELEVATIONS INDICATED.

END OF SECTION