Fair Haven
Community Health Care

PROJECTSPECIFICATIONS/MANUAL – Volume 2

Fair Haven Community Health Renovations

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Table of Contents

Section	Title
	Cover
	Table of Contents
210500	Basic Fire Protection Requirements
210517	Sleeve and Sleeve Seals For Fire-Suppression Piping
210518	Escutcheons for Fire-Suppression Piping
211313	Wet-Pipe Sprinkler Systems
220500	Basic Plumbing Requirements
220523	General-Duty Valves for Plumbing Piping
220529	Hangers and Supports
220553	Identification for Plumbing Piping and Equipment
220719	Plumbing Insulation
221116	Domestic Water Piping
221316	Sanitary Waste and Vent Piping
224000	Plumbing Fixtures
230500	Basic Heating, Ventilation and Air Conditioning Requirements
230593	Testing, Adjusting and Balancing for HVAC
230700	HVAC Insulation
233100	Ducts
233300	Ductwork Accessories
233717	Air Outlets and Inlets
260500	Basic Electrical Requirements
260505	Minor Electrical Demolition
260519	Conductors and Cable
260526	Grounding and Bonding
260529	Electrical Hangers and Supports
260533.13	Conduit
260533.16	Boxes
260553	Electrical Identification
260800	Electrical Testing
262416	Panelboards
262726	Wiring Devices
262816	Circuit Breakers
262817	Disconnect Switches
262913.03	Enclosed Motor Starters
264820	Fire Alarm System - Non-Voice
264900	Components and Accessories
265100	Luminaires

DOCUMENT1

END OF SECTION

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SECTION 210000

BASIC FIRE PROTECTION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes basic Fire Protection requirements and general conditions.

B. Related Sections

1. Section 011400 – Work Restrictions

2. Section 017700 - Closeout Procedures

1.2 REFERENCES

A. International Building Code – IBC 2021

B. International Plumbing Code – IPC 2021

C. International Energy Conservation Code – IECC 2021

D. Connecticut State Building Code, 2022, Supplements and Amendments.

E. Connecticut Fire Safety Code, 2016, Supplements and Amendments.

F. NFPA 13 – Standard for the Installation of Sprinkler Systems

1.3 SUBMITTALS

A. Submit manufacturer's drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

B. Mark dimensions and values in units to match those specified.

C. Submit manufacturer's drawings, bill of material, equipment layouts, catalog data, wiring diagrams and other documentary or descriptive information for each assembly.

D. Provide a schedule of all fire protection system related Owner training within one month after Notice to Proceed. Confirm the date(s) and time(s) with Owner two weeks prior to actual training session(s) and resubmit schedule. At a minimum, for each piece of equipment or system to be demonstrated, the schedule should include the following,

1. Equipment or system to be demonstrated

2. Related specification section

3. Anticipated date of training

4. Anticipated duration of training session

5. Name and company of instructor providing the training

6. Date completed

7. Actual duration of training session

Resubmit schedule upon completion of all training.

E. Refer to individual specification sections for additional submittal information.

F. Submitted shop drawings of fire sprinkler system(s) and hydraulic calculation(s) shall be sealed and signed by a Professional Engineer registered to practice engineering in the State of Connecticut or licensed Level IV Layout Fire Protection Technician registered in the State of Connecticut.

G. Each submittal shall be reviewed, stamped and certified prior to submission. Such certification shall be made by the Owner, or Corporate Officer of the Contractor, or by a person duly authorized by the Owner to sign binding agreements for the Contractor. The certification shall state that the data and details contained on each shop drawing, layout drawing, catalog data and brochure has been reviewed by the Contractor and that it complies with the Contract Documents in all respects. Shop drawings, layout drawings, catalog data and brochures will not be reviewed and will be returned to the Contractor unchecked unless they are certified.

H. All fire protection submittals shall be submitted in a single package. "Piece-Meal" or "Partial" submittals will not be accepted, and will be rejected and returned without review, unless prior approval from the Engineer has been obtained. NO EXCEPTIONS.

1. The submittals for the entire Fire Protection Division Series Sections shall be submitted at the same time, not "section-by-section."

2. Each section shall be tabbed, by fire protection specification section, and include al materials specified in that section.

3. The shop drawings shall be submitted within 90 days of execution of the Contract.

4. An index shall be provided indicating:

    a. A complete shop drawing log depicting ALL submittals to be provided for the Division, whether included in the full package or not. Log shall be updated to reflect the submittals provided

    b. Specification section

    c. Product

    d. Plan code

    e. Supplier, Manufacturer, Model Number, Contact List, etc.

I. Fire Protection long lead items are excluded from this requirement but must be submitted complete in their entirety by specification section, when provided.

J. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and layouts coordinated with other trades and utilities. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the material or equipment which have been properly reviewed.

K. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Contract. Refer to the General Conditions for the quantity of copies required for submission.

L. Provide shop drawings for all devices specified under equipment specifications for all systems, materials, equipment and/or devices. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all sprinkler heads) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.

1. Equipment shop drawings shall contain full range performance curves, graphs, tables or other pertinent data which clearly indicates operational range of a given unit size. Computer generated/plotted curves, based solely on design performance, will not be accepted.

2. All specific options and/or alternatives shall be clearly indicated. Failure to do so shall be grounds for rejection.

M. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer. The Contractor shall incur all costs associated with delay of construction due to equipment and/or materials arriving late due to late or improper shop drawing submittal.

N. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

O. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not indicate that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.

P. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.

Q. Acceptance of shop drawings is final, and no further changes will be allowed without the written consent of the Engineer.

R. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

S. Contractor shall make any corrections required by Engineer and shall resubmit required number of corrected copies of shop drawings or new samples until accepted. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than corrections requested by Engineer on previous submissions. Engineer shall review no more than one resubmittal of any shop drawing or sample at

Owner's expense. The fees for review of additional resubmittals shall be paid by the Contractor at the Engineer's standard rates.

T. Conform the Fire Protection work to the requirements herein. Provide offsets, fittings, drains, and accessories which may be required to accommodate structural, HVAC, plumbing, existing conditions, etc. Investigate the structural and finish conditions affecting the work, and arrange the work accordingly. Provide such piping, fittings, valves, and accessories as may be required to meet such conditions.

1.4 CLOSEOUT PROCEDURES

A. Prior to final acceptance of the Work, provide all closeout documentation in accordance with Section 017700.

B. Provide, for the Owner's use, a hard copy and PDF file of NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

1.5 REGULATORY REQUIREMENTS

A. Conform to all codes listed under References in this Section.

B. Conform to all applicable Local Building Codes.

C. Obtain and pay for all applicable permits.

1.6 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner's Project Representative before proceeding.

C. Locations of fire protection equipment, piping, and sprinkler heads, as indicated on Engineer's plans, are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is significantly different from that indicated, the Owner's Project Representative must give approval to the change.

1.7 WORK RESTRICTIONS

A. Refer to section 011400 Work Restrictions, for restrictions during construction.

1.8 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications are typical of work done and of arrangement desired. Provide all accessories and appurtenances necessary for complete systems.

B. As-Built Drawings: Maintain a master set of as-built drawings showing the changes and deviations from the contract drawings or the approved shop drawings. Make markups as the changes are made. Submit as-built documentation to Engineer by substantial completion.

1.9 WARRANTY

A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts, and adjustments required due

to failure in materials or workmanship within one year from final acceptance of the Work.

B. During this warranty period, Contractor shall answer all service calls at no expense to the Owner. All defects developing through faulty materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Owner's satisfaction.

C. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty is in addition to all other warranties existing under either the Contract Documents or required by Law.

1.1 BASES AND SUPPORTS

A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, and framing required for all equipment furnished under this Division.

B. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

1.2 FIRE STOPS AND SEALS

A. Fire-stopping systems shall be submitted as shop drawing.

B. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved firestop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.

1.3 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

1.4 RESTRICTIONS

A. Piping shall not be run in any concrete floor slab. Written approval from the Structural Engineer may be obtained only after submission and approval of a layout shop drawing.

END OF SECTION

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SECTION 210517

SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.

1.2 SUBMITTALS

A. Product Data:

1. Sleeves.

PART 2 PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

PART 3 EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

C. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

END OF SECTION

SECTION 210518

ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Escutcheons.

PART 2 PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, and ceilings.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

d. Bare Piping at Wall Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.

b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.

f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 211313

WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.

2. Cover system for sprinkler piping.

3. Sprinklers.

1.2 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified Installer and professional engineer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

F. Welding certificates.

G. Fire Pump flow test report.

H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

I. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire pump flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.7 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify General Contractor and Owner no fewer than two days in advance of proposed interruption of sprinkler service.

2. Do not proceed with interruption of sprinkler service without General Contractor and Owner's written permission.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

2. NFPA 25.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

b. Sprinkler Occupancy Hazard Classifications:

1) Office, Exam Rooms, and Public Areas: **Light Hazard**.

2. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.

3. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft.

b. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized and Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Thinwall Galvanized and Black Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

C. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

D. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M thinwall with plain ends and wall thickness less than Schedule 10.

E. Galvanized and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

F. Galvanized and Uncoated Steel Couplings: ASTM A 865/A 865M, threaded.

G. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

H. Malleable- or Ductile-Iron Unions: UL 860.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Pressure Rating: 175-psig minimum.

2. Galvanized and Painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.

3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

K. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.3 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Standard: UL 213.

2. Pressure Rating: 175-psig minimum.

3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

4. Type: Mechanical-tee and -cross fittings.

5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flexible Sprinkler Hose Fittings:

1. Standard: UL 1474.

2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.

3. Pressure Rating: 175-psig minimum.

4. Size: Same as connected piping, for sprinkler.

2.4 SPRINKLERS

A. Available manufacturers:

1. Reliable Automatic Sprinkler Co., Inc.

2. Tyco Fire and Building Products.

3. Victaulic Fire Protection.

4. Viking Corp.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.

2. Nonresidential Applications: UL 199.

3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

4. Nominal Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.

E. Sprinkler Finishes: Chrome plated.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated/White finished steel, two pieces, with vertical adjustment.

2. Sidewall Mounting: Chrome-plated/White finish steel, one piece, flat.

G. Sprinkler Guards:

1. Standard: UL 199.

2. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 EXECUTION

3.1 PREPARATION

A. Obtain recent fire pump flow test according to NFPA 13. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install sprinkler piping with drains for complete system drainage.

F. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

G. Fill sprinkler system piping with water.

H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

I. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

E. 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 burs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

F. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

G. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

I. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.5 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.

5. Coordinate with fire-alarm tests. Operate as required.

6. Coordinate with fire-pump tests. Operate as required.

7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.8 PIPING SCHEDULE

A. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

3.9 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.

2. Rooms with Suspended Ceilings: Recessed sprinklers.

3. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

2. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view.

END OF SECTION

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SECTION 220000

BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes basic Plumbing requirements and general conditions.

B. Related Sections

1. Section 011400 – Work Restrictions

2. Section 017700 – Closeout Procedures

3. Section 013300 – Submittal Procedures

1.2 REFERENCES

A. International Building Code – IBC 2021

B. International Plumbing Code – IPC 2021

C. International Energy Conservation Code – IECC 2021

D. Connecticut State Building Code, 2022, Supplements and Amendments.

1.3 SUBMITTALS

A. Comply with the requirements in Section 013300, Submittal Procedures.

B. Submit manufacturer's drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Submit manufacturer's drawings, bill of material, equipment layouts, catalog data, wiring diagrams and other documentary or descriptive information for each assembly.

E. Provide a schedule of all plumbing system related Owner training within one month after Notice to Proceed. Confirm the date(s) and time(s) with Owner two weeks prior to actual training session(s) and resubmit schedule. At a minimum, for each piece of equipment or system to be demonstrated, the schedule should include the following,

1. Equipment or system to be demonstrated

2. Related specification section

3. Anticipated date of training

4. Anticipated duration of training session

5. Name and company of instructor providing the training

6. Date completed

7. Actual duration of training session

Resubmit schedule upon completion of all training.

1.4 CLOSEOUT PROCEDURES

A. Prior to final acceptance of the Work, provide all closeout documentation in accordance with Section 017700.

1.5 REGULATORY REQUIREMENTS

A. Conform to all codes listed under References in this Section.

B. Conform to all applicable Local Building Codes.

C. Obtain and pay for all applicable permits.

1.6 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner's Project Representative before proceeding.

C. Location of plumbing equipment and piping, as indicated, are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is significantly different from that indicated (greater than 5 feet away from the location shown on drawings), the Owner's Project Representative must give approval to the change.

1.7 WORK RESTRICTIONS

A. Refer to section 011400 Work Restrictions, for restrictions during construction.

1.8 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications are typical of work to be completed and of arrangement desired. Provide all accessories and appurtenances necessary for complete systems.

B. As-Built Drawings: Maintain a master set of as-built drawings showing the changes and deviations from the contract drawings or the approved shop drawings. Make markups as the changes are made. Submit as-built documentation to Engineer by substantial completion.

1.9 WARRANTY

A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts, and adjustments required due to failure in materials or workmanship within one year from final acceptance of the Work.

B. During this warranty period, Contractor shall answer all service calls at no expense to the Owner. All defects developing through faulty materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Owner's satisfaction.

C. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty

is in addition to all other warranties existing under either the Contract Documents or required by Law.

1.1 BASES AND SUPPORTS

A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, framing, bases and piers required for all equipment furnished under this Division.

B. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

1.2 FIRE – STOPS AND SEALS

A. Fire-stopping systems and assemblies shall be submitted as a shop drawing.

B. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire-stop assembly classified for an hourly rating equivalent to the fire rating of the wall, ceiling, or floor.

1.3 ACCESSIBILITY AND PANELS

A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work.

B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to, motors, controllers, valves, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer

C. Access doors in walls, ceilings, floors, etc., shall be field coordinated. It is the responsibility of the Contractor to coordinate and provide information regarding the sizes and quantities of access doors required for his work. The Contractor shall arrange his work in such a manner as to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.

D. On a clean set of drawings, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect for review before access doors are purchased or installed.

E. Upon completion of the Project, the Contractor shall physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels by the installing Contractor at no additional cost to the Owner.

1.4 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

1.5 PAINTING

A. All finish painting in completed areas shall be performed per Division 9 of the Specifications.

B. All materials shipped to the job site under this Division shall have standard manufacturer's finish, unless otherwise specified.

1.6 QUIET OPERATION

A. Equipment and material used in the various systems described herein shall not produce a sound level greater than 55 decibels in the area served. If noise level is deemed objectionable by the Owner/Engineer, the Contractor shall test and record sound levels in the presence of the Owner/Engineer. The sound level shall be observed on the "A" weighting network of a sound level or sound survey meter. The ASHRAE "Guide and Data Book" provides a means to determine sound level of mechanical equipment when the total of background plus equipment sound levels exceeds the minimum acceptable equipment sound level.

B. If objectionable noises or vibrations of any magnitude are produced and transmitted to occupied portions of the building by apparatus, piping, or other parts of the plumbing work, the Contractor shall make such changes or additions as necessary without extra cost to the Owner.

1.7 LUBRICATION

A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner. Units furnished with sealed bearings are exempted.

B. The Contractor shall furnish and install, as appropriate on all equipment requiring lubrication, Zerk pressure gun grease fittings or sight gravity-feed oilers equipped with shutoff and needle valve adjustment. Units furnished with sealed bearings and lifetime lubrication are exempted. All fittings and oilers are to be fully accessible for lubrication with equipment which does not require special adapters. Where fittings would be otherwise inaccessible, furnish and install extended grease lines.

1.8 RESTRICTIONS

A. Plumbing equipment provided under this Division may not be used for temporary requirements due to premature wear and dirt/dust infiltration. Written approval may be obtained from the Owner only after submission of a written cleaning plan and guarantee extension.

B. Piping shall not be run in any concrete floor slab. Written approval from the Structural Engineer may be obtained only after submission and approval of a layout shop drawing.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball Valves
2. Butterfly valves
3. Check valves

B. Related Sections:

1. Section 220719 – Plumbing Insulation
2. Section 221116 – Domestic Water Piping

1.2 REFERENCES

A. ASTM International:

1. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
2. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
3. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 67 - Butterfly Valves.
2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
4. MSS SP 72 - Ball Valves, Flanged or Butt-Welding Ends
5. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
6. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
7. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
8. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

C. Underwriters Laboratories Inc.:

1. UL 842 - Valves for Flammable Fluids.

1.3 SUBMITTALS

A. Product data including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1. Certification that products comply with NSF 61 Annex G.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

D. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

1.6 WARRANTY

A. Furnish one year manufacturer warranty for valves excluding packing.

1.7 EXTRA MATERIALS

A. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.

2. ASME B16.1 for flanges on iron valves.

3. ASME B16.5 for pipe flanges and flanged fittings, NPS 1/2 through NPS 24 on steel valves.

4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

5. ASME B16.18 for solder-joint connections.

6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.

D. Interior coating of iron and steel valves shall be suitable for potable water service in accordance with AWWA C550.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

G. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valves in Insulated Piping:

1. Include 2-inch stem extensions.

2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.

3. Memory stops that are fully adjustable after insulation is applied.

J. Refer to Part 3 for applications of valves.

2.2 BALL VALVES

A. Manufacturers:

1. Bronze and Steel Ball Valves

a. Apollo

b. Watts

c. NIBCO

d. Or equal

B. BRONZE BALL VALVES

1. Description:

a. Standard: MSS SP-110.

b. Working Pressure Rating: 600 psig.

c. Body Design: Two piece.

d. Body Material: Lead free Bronze.

e. Ends: Threaded, soldered.

f. Seats: PTFE.

g. Stem: Stainless steel.

h. Ball: Stainless steel, vented.

i. Port: Full.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

F. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

G. Install valves with clearance for installation of insulation and allowing access.

H. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. NPS 2” and smaller:

    a. Shutoff Service: Ball.

C. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Ball Valves: May be provided with solder-joint ends instead of threaded ends.

2. Bronze Ball valves, two-piece with full port and stainless-steel trim.

END OF SECTION

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SECTION 220529

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Manufactured piping hangers and supports

2. Miscellaneous materials

B. Related Sections

1. Section 220500 – Basic Plumbing Requirements

1.2 REFERENCES

A. Manufacturers' Standardization Society SP-58, Pipe Hangers and Supports - Materials Design and Manufacture, Selection and Application, Fabrication and Installation Practices

B. Manufacturers' Standardization Society SP-90, Guidelines on Terminology for Pipe Hangers and Supports

C. ASTM A 36 - Specification for Structural Steel

D. ASTM A 123 –Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

E. ASTM A 780 - Practice for Repair of Damaged Hot Dipped Galvanized Coatings

F. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel

G. ASTM C 150 - Specification for Portland Cement

H. ASTM C 404 - Specification for Aggregates for Masonry Grout

I. ASME B 31.9 - Building Services Piping

J. American Welding Society (AWS) Structural Welding Code

1.3 DESIGN REQUIREMENTS

A. The design of each pipe support and pipe support framework shall be the responsibility of the Contractor. Shop drawings, as specified below, shall be submitted and shall show all details of the installation, including dimensions and types of support. In all instances, the completed frame shall be adequately braced to provide a complete rigid structure when all piping has been attached.

1.4 SUBMITTALS

A. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements and complies with Manufacturers' Standardization Society Standards.

C. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.

D. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

1.5 QUALITY ASSURANCE

A. Provide anchors and supports in conformance with the Manufacturers Standardization Society of the Valve and Fitting Industry, Inc. (MSS). All materials, design, manufacture, selection, application and fabrication shall be in conformance with the appropriate MSS numbers.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code-Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has underground re-certification.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufactured Piping Hangers and Supports - Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall be stainless steel where installed for stainless steel piping. As a minimum, components to be stainless steel include clevis hangers, pipe clamps, pipe supports, plate bases, pipe saddles, U-bolts, floor stanchions, threaded rod with nuts, rod couplings, brackets and all miscellaneous connecting and supporting hardware. Structural steel work required for pipe racks and trapezes shall be A-36 steel, sandblasted, primed and finish painted using the approved paint system for this project.

2. As a minimum, all components shall have hot-dipped galvanized coatings where installed for all other piping and equipment.

3. Components shall have a plastic coating where installed for piping and equipment in chemical feed areas.

4. Pipe attachments shall have plastic coating for electrolytic protection where attachments are in direct contact with copper tubing.

5. Hangers and supports with a copper coating will not be acceptable.

6. All hangers and supports shall have some form of adjustment available after installation.

7. Hanger rods shall be subjected to tension only. Lateral and axial movements shall be accommodated by proper linkage in the rod assembly.

8. Strut channel hangers shall be used to support parallel piping. Strut clamps, straps, and rollers shall be used to maintain proper alignment. Thermal expansion roller hangers shall be utilized for all heating supply and return lines. Strut channel trapeze hanger systems shall be hot-dipped galvanized after fabrication (ASTM A123). Hardware shall be electro-plated zinc (ASTM B633).

B. Miscellaneous Materials

1. Steel Plates, Shapes, and Bars shall conform to ASTM A 36.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which supports and anchors are to be installed. Do not proceed with installing until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-58.

B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers. Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.

C. Install supports with maximum spacings complying with MSS SP-58.

D. Install supports with minimum rod diameter complying with MSS SP-58.

E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

G. Install hangers and supports so that piping live and dead loading and stress from movement will not be transmitted to connected equipment.

H. Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.

I. Insulated Piping - Comply with the following installation requirements.

1. Clamps - Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

2. Saddles - Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.

3. Shields - Install protective shields MSS Type 40 on cold and chilled water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in accordance with MSS SP-58.

4. Insert material shall be at least as long as the protective shield.

5. Thermal Hanger Shields - Install where indicated, with insulation of same thickness as piping.

J. Anchors

1. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

2. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.

3. Anchor Spacings - Where not otherwise indicated, install anchors at ends of principal pipe runs. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.3 CONSTRUCTION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding - Comply with AWS D1-1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contoured welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustment - Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.5 CLEANING

A. For galvanized surfaces clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe labels.

2. Valve tags.

1.2 REFERENCES

A. ASME A13.1 – Latest pipe marking standard guide for the identification of pipes.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Piping Label Schedule: Include a listing of all equipment and piping to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Labels and Warning Signs

1. Brady Corp.

2. Seton Identification Products

3. National Marker Company

4. Or Equal

2.2 GENERAL

A. When Owner's labeling standards are different from those specified, observe and follow Owner's standard labeling system.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using full fluid name or same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

3. Sufficient additional details such as temperature, pressure etc. as required to identify the hazard.

E. Pipe label color schedule:

1. Domestic Cold Water Piping: White letters on a green background.

2. Domestic Hot Water Piping: White letters on a green background.

3. Sanitary Waste Piping: White letters on a black background.

4. Sanitary Vent Piping: White letters on a black background.

2.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link chain or beaded chain.

B. Valve-Tag Size and Shape: 1-1/2” x 1-1/2”, square.

C. Valve-Tag Colors shall match the equipment or pipe labels depending on location.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper and electronic version. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations and on both sides of walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run.

7. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.5 ADJUSTING

A. Relocate mechanical identification tags and provide additional labels where tags and labels have been visually blocked by other work.

3.6 CLEANING

A. Clean all identification tags and labels.

END OF SECTION

SECTION 220700

PLUMBING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Piping Systems Insulation:

a. Fiberglass.

b. Closed cell elastomeric.

B. Related Sections

1. Section 221116 – Domestic Water Piping

2. Section 221316 – Sanitary Waste and Vent Piping

1.2 REFERENCES

A. ASTM C 533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation

B. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

C. ASTM C 547 - Specification for Mineral Fiber Preformed Pipe Insulation.

D. ASTM C 553 - Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type).

E. ASTM C 612 - Specification for Mineral Fiber Block and Board Thermal Insulation.

F. ASTM C 921 - Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

G. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.

B. Installers' Qualifications - Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for the project.

C. Flame/Smoke Ratings - Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1. Exception - Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

2. Exception - Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer - Subject to compliance with requirements, provide products of one of the following:

1. Knauf Fiber Glass GmbH.

2. Manville Products Corp.

3. Owens-Corning Fiberglass Corp.

4. Childers Products Co.

5. Specialty Products and Insulation Co.

6. Or equal

B. Manufacturers for Closed Cell Elastomeric Insulation Products:

1. Aeroflex, Aerocell.

2. Armacell, LLC. Armaflex.

3. K-Flex USA LLC

4. Or equal.

2.2 MATERIALS

A. Piping Insulation

1. Fiberglass Piping Insulation - ASTM C 547, Type 1, ASTM E84, unless otherwise indicated.

a. Thermal Conductivity: 0.24 Btu-in/ (h-sq. ft-degrees F) at 75 degrees F.

b. Operating Temperature Range: 0 to 850 degrees F.

c. Jacket: Factory applied vapor retarder, 0.02 maximum vapor permeance, ASTM C1136

2. Type I, flexible, closed cell elastomeric insulation, tubular.

a. Thermal Conductivity: maximum of 0.24Btu-in/ (h-sq. Ft-degrees F) at 75 degrees F.

b. Operating Temperature Range: Minus 70 to 180 degrees F.

c. Manufactured without CFCs, HFCs, HCFCs, or formaldehyde

d. Water vapor permeability less than 0.05 perm-inches

e. Flame spread index less than 25 and smoke spread index less than 50 tested to ASTM E84.

f. Material: Nitrile butadiene rubber / PVC or EPDM rubber. Polyethylene insulation is not acceptable.

3. Jackets for Piping Insulation - ASTM C921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

a. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations.

b. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

4. Vapor-Barrier Mastic: Water based, suitable for indoor use on below-ambient services.

a. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

b. Service Temperature Range: Minus 20 to plus 180 deg F.

c. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

d. Color: White.

5. Vapor-Barrier Mastic: Solvent based, suitable for indoor use on below-ambient services.

a. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.

b. Service Temperature Range: 0 to 180 deg F.

c. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.

d. Color: White.

6. Breather Mastic: Water based, suitable for indoor and outdoor use on above-ambient services.

   a. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.

   b. Service Temperature Range: Minus 20 to plus 180 deg F.

   c. Solids Content: 60 percent by volume and 66 percent by weight.

   d. Color: White.

7. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

   a. Materials shall be compatible with insulation materials, jackets, and substrates.

   b. Fire- and water-resistant, flexible, elastomeric sealant.

   c. Service Temperature Range: Minus 40 to plus 250 deg F.

   d. Color: White.

8. Factory-Applied Jackets

   a. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

      1) ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

9. Piping Insulation Accessories - Provide staples, bands, wires, and cement as recommended by insulation manufacturer for applications indicated.

10. Piping Insulation Compounds - Provide adhesives, sealers, and protective finishes as recommended by insulation manufacturer for applications indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INTERIOR PIPING INSULATION APPLICATION

A. Plumbing Piping

1. Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and pre-insulated equipment.

2. Potable Cold Water Piping:

a. Operating Temperature: 35 to 75 degrees F.
b. Insulation material: Closed cell elastomeric with ASJ.
c. Thermal conductivity: 0.21 – 0.27 Btu-in./(h-ft^2-˚F)
d. Insulation thickness:
    1) All sizes: 1 inch

3. Potable Hot Water and Recirculating Hot Water Piping:

a. Operating Temperature: 100 to 140 degrees F.
b. Insulation material: Fiberglass with ASJ.
c. Thermal conductivity: 0.21 – 0.28 Btu-in./(h-ft^2-˚F)
d. Insulation thickness:
    1) Pipe 1-1/4 inches and smaller: 1 inch
    2) Pipe 1-1/2 and larger: 1.5 inches

3.3 INSTALLATION

A. General

1. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Piping Insulation

1. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

2. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

3. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

4. Maintain integrity of vapor-barrier jackets on pipe insulation and protect to prevent puncture or other damage.

5. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

6. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

7. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3” wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.

8. On cold piping and where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    a. Install insulation continuously through hangers and around anchor attachments.

b. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

c. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

9. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

3.4 REPAIR/RESTORATION

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units, at no additional cost to the Owner.

3.5 PROTECTION

A. The Contractor shall provide the required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

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SECTION 221116

DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Domestic water piping including:

a. Potable cold water piping

b. Potable hot water piping

c. Fittings and specialties

B. Related Sections

1. Section 220523 - General-Duty Valves for Plumbing Piping

2. Section 220529 - Hangers and Supports

3. Section 220553 - Identification for Plumbing Piping and Equipment

1.2 REFERENCES

A. ASME B31.9 - Code for Pressure Piping - Building Services Piping

B. ASTM A126 - Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings

C. ASTM B32 - Specification for Solder Metal

D. ASTM B88 - Specification for Seamless Copper Water Tube

E. AWWA C651 - Standard for Disinfecting Water Mains

1.3 DEFINITIONS

A. Domestic water piping is defined as follows:

1. Where there is a metering device inside the building or structure to which the water is being delivered for use, the domestic water piping shall begin at the outlet or house side of the metering device which is closest to the inside face of the outermost foundation wall of that building or structure; and

2. Where there is no metering device inside the building or the structure to which the water is being delivered for use, the domestic water piping shall begin at the outlet or “house” side of the main control valve which is closest to the inside face of the outermost foundation wall of that building or structure.

B. Water Service Piping - The pipe from the water main or other source of potable water supply, to the water distributing system of the building served.

C. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

1.4 SUBMITTALS

A. Comply with the provisions of Section 220500.

B. Product data for each pipe material, pipe fitting, piping specialty and valve specified. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Certification of Compliance with ASME and UL fabrication requirements where specified.

D. Test reports specified in Part 3 of this Section.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements - comply with the provisions of the following:

1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

B. Comply with the provisions of Section 220500 regarding permit requirements, welder certifications and documentation.

C. The manufacturer's name and pressure rating shall be marked on valve body.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with the provisions of Section 220500 and 15112.

1.7 SEQUENCING

A. Coordinate the installation of pipe sleeves for wall and floor penetrations.

1.8 EXTRA MATERIALS

A. Maintenance Stock - Furnish one valve key for each key operated faucet installed.

B. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer - Subject to compliance with requirements, provide products by one of the following:

1. Dielectric Waterway Fittings

a. Victaulic Company of America

b. Grinnel Corp.

c. Pipeco.

d. Or equal

2. Dielectric Unions

a. Perfection Corp.

b. Watts Regulator Co.

c. Grinnel Corp.

d. Or equal

3. Thermostatic Mixing Valves

a. Bradley

b. Haws

c. Leonard Valve Co.

d. Or equal

2.2 MATERIALS

A. All materials used for public water systems or plumbing system providing water for human consumption shall be lead free as defined by the Reduction of Lead in Drinking Water Act.

B. Piping

1. Above grade - Drawn Temper Copper Tubing - ASTM B88, Type L.

C. Fittings

1. Wrought-Copper Fittings - ANSI B16.22, Streamlined pattern.

2. Cast Bronze Flanges - ANSI B16.24, Class 150; raised ground face, bolt holes spot faced.

3. Unions - ANSI B16.39, malleable iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.

4. Dielectric Unions - Threaded or soldered end connections as required to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

D. Joints and Joining Materials

1. Solder Filler Metals - ASTM B32, 95-5 Tin-Antimony.

E. General duty valves (i.e., ball valve) are specified in Section 220523. Special duty valves are specified below by their generic name; refer to Part 3 Paragraph 3.8 "VALVE APPLICATION" for specific uses and applications for each valve specified.

F. Balance Valves shall be Class 125, bronze body, bronze plugs, screw driver operated, straight or angle pattern, with soldered end connections.

G. Pressure Regulating Valves shall be single seated, direct operated type; having bronze body with integral strainer, and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and inlet and outlet pressures indicated.

H. Anchor bolts, nuts, washers, and bolt sleeves shall be in accordance with Section 220500.

I. Sleeves and seals shall be in accordance with Section 220500.

2.3 FINISHES

A. Comply with the provisions of Section 220500.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with the provisions of Section 220500.

3.3 PIPING INSTALLATION

A. Comply with the provisions of Section 220500.

B. General Locations and Arrangements - Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

C. Use fittings for all changes in direction and all branch connections.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

E. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

F. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

G. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1“ clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

H. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, ¾ inch ball valve, and short ¾ inch threaded nipple and cap.

J. Install piping level with no pitch.

K. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building.

L. Pipe identification and marking is included in Section 220553.

M. Hanger, supports and anchor devices shall be in accordance with Section 220529.

N. Insulate piping in accordance with Section 220719.

3.4 INSTALLATION OF VALVES

A. Sectional Valves - Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inch and smaller, use ball valves; for sectional valves 2½ inch and larger, use ball or butterfly valves.

B. Shutoff Valves - Install shutoff valves on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated. For shutoff valves 3 inch or smaller, use ball valves; for shutoff valves 4 inch and larger, use ball or butterfly valves.

C. Drain Valves - Install drain valves on each plumbing equipment item, located to completely drain equipment for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to completely drain distribution piping system. For drain valves 3 inch and smaller, use ball valves; for drain valves 4 inch and larger, use ball or butterfly valves.

3.5 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures - Provide water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code.

3.6 PIPE APPLICATIONS

A. Install Type L, drawn copper tubing with wrought copper fittings and solder joints for 4 inch and smaller, above ground within building.

3.7 VALVE APPLICATIONS

A. General Duty Valve Applications - The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shut-off Duty - use ball valves.

3.8 FIELD QUALITY CONTROL

A. Inspections

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

a. Rough-in Inspection - Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.

b. Final Inspection - Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.

3. Re-inspections - Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.

4. Reports - Prepare inspection reports, signed by the plumbing official.

3.9 TESTING

A. Test for leaks and defects in all new water distribution piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested

B. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.

C. Cap and subject the piping system to a static water pressure of 125 psig. Isolate the test source and allow to stand for a period of 4 hours. Leaks and loss in test pressure constitute defects which must be repaired.

D. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

E. Prepare reports for all tests and required corrective action.

3.10 CLEANING AND DISINFECTION

A. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use.

B. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in AWWA C651, or as described below:

1. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.

2. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.

3. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.

4. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water going from the system.

5. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

C. Prepare reports for all purging and disinfecting activities.

D. Do not discharge chlorinated water to the environment, in order to prevent chlorinated water from entering groundwater or surface water. All flushing water must be collected and disposed of properly.

E. The discharge of water used for chlorination and flushing of the water mains shall be in strict conformance with all applicable local, state and federal regulations. Either completely dechlorinate the water prior to its discharge to the environment or, alternatively, collect all water and haul off site for proper disposal at a wastewater treatment plant. All costs associated with the discharge and/or disposal of the water used for chlorination and/or flushing shall be included in the work.

END OF SECTION

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SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Piping, tubing and fittings.

2. Specialty pipe and fittings.

3. Sanitary, waste, and vent systems.

B. Related Sections:

1. Section 220000 – Basic Plumbing Requirements

2. Section 220553 – Identification for Plumbing Piping and Equipment

3. Section 220719 – Plumbing Insulation

1.2 REFERENCES

A. ASTM D2661 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings

B. ASTM D2665 - Specification for Polyvinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

1.3 DEFINITIONS

A. Building Drain - That part of the lowest horizontal piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the drainage system.

B. Vent System - A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.4 SUBMITTALS

A. Product data: For pipe, tube, fittings, couplings, and gaskets.

B. Shop Drawings: Include plans, elevations, sections, and details.

C. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear the seals of specified testing and standards agencies.

1.6 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe or coatings. Examine all pipe and fittings before installing. Defective pipe and fittings shall not be installed.

B. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner.

C. All pipe and fittings shall be cleaned before installing and be kept clean until they are used in the work, and when installed shall conform to the lines, grades and dimensions required.

D. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

E. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer - Subject to compliance with requirements, sanitary and vent systems from one of the following or equal:

1. Ancon, Inc.
2. Josam Mfg. Co.
3. Jay R. Smith Mfg. Co.
4. Tyler Pipe; Subs. of Tyler Corp.
5. Zurn Industries, Inc.; Hydromechanics Div.
6. Or equal

2.2 MATERIALS

A. Above Ground Piping and Fittings

1. Polyvinyl Chloride (PVC) Pipe – Solid wall, Schedule 40, ASTM D2665 with PVC socket fittings made to ASTM D3311 and to fit Schedule 40 pipe. Adhesive Primer: ASTM F656. Solvent Cement: ASTM D2564. Comply with NSF 14 for plastic piping components. Include marking with “NSF-dwv” for plastic drain, waste, and vent piping and “NSF-sewer” for plastic sewer piping.
2. Acrylonitrile Butadiene Styrene (ABS) Pipe - Solid wall, Schedule 40, ASTM D2661 with ABS socket fittings made to ASTM D3311 and to fit Schedule 40 pipe. Solvent Cement: ASTM D2235. Comply with NSF 14 for plastic piping components. Include marking with “NSF-dwv” for plastic drain, waste, and vent piping and “NSF-sewer” for plastic sewer piping.

B. Clean out plugs – See drawing schedules for details.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

C. Examine walls, floors, roof, and plumbing changes for suitable conditions where carriers, piping and specialties are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected at no additional cost to the Owner.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements - Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated. Drain locations as shown on the plans are approximate and may have to be varied in the field. Coordinate with the GC and all trades to avoid conflicts.

B. Use fittings for all changes in direction and all branch connections.

C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications and valve access.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Make changes in direction for drainage and vent piping using approximate 45° wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical. Use long-turn tees where two fixtures are installed back-to-back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90° shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

H. Install building drain pitch down at minimum slope of ¼ inch per foot (2%) for piping 2-1/2 inch and smaller, 1/8 inch per foot (1%) for piping 3 inch to 6 inch and 1/16 inch per foot (0.5%) for piping 8 and larger.

I. Extend building drain to connect to drainage piping, of size and in location indicated for service exit from the building.

J. Hanger, supports, and anchor devices shall be in accordance with Section 220529.

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Install expansion joints on vertical risers as indicated, and as required by the plumbing code.

B. Above Ground Cleanouts - Install in above ground piping and building drain piping as indicated, and:

1. as required by plumbing code;

2. at each change in direction of piping greater than 45°;

3. at minimum intervals of 50' for piping 4 inch and smaller; 100’ for piping larger than 4 inch.

4. at base of each vertical soil, waste, or roof drainage stack.

3.4 CONNECTIONS

A. Piping Runouts to Fixtures - Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.

B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.5 PIPE APPLICATIONS

A. Above Ground, Within Building

1. Install aboveground ABS piping according to ASTM D 2661.

2. Install aboveground PVC piping according to ASTM D 2665.

3.6 FIELD QUALITY CONTROL

A. Inspections

1. Do not enclose, cover, or put into operation drainage and vent piping systems until it has been tested, inspected, and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

a. Rough-in Inspection - Arrange for inspection of the piping system before concealing and prior to setting fixtures.

b. Final Inspection - Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.

3. Reinspection - Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official.

4. Reports - Prepare test and inspection reports, to be signed by the plumbing official.

B. Piping System Test - Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects for all new drainage and vent piping systems and parts of existing systems, which have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.

3. Rough Plumbing Test Procedure – Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.

4. Finished Plumbing Test Procedure – After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building and introduce air into the system equal to a pressure of 1 inch water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.

5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

6. Prepare reports for all tests and required corrective action.

3.7 CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

C. Flush and clean new storm, waste, and sanitary drain piping to remove debris and blockages. Drainage systems will be rejected if blockages exist, and clear flow is not observed.

D. Flush and clean existing waste and sanitary drain piping (to remain in service) to remove debris and blockages back to the building main drain. Drainage system modifications will be rejected if blockages remain, and clear flow is not observed. Coordinate with GC and engineer if blockages can't be removed.

3.8 PROTECTION

A. Protect drains with suitable covering during the remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place protective plugs in open ends of uncompleted piping at end of day or whenever work is paused or stops for the day.

END OF SECTION

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SECTION 224000

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Lavatories
2. Water Closets
3. Flush Tanks
4. Faucets
5. Fixture Supports
6. Toilet Seats
7. Fittings, Trim and Accessories

B. Related Sections

1. Section 079200 - Joint Sealants
2. Section 221116 - Domestic Water Piping
3. Section 221316 - Sanitary Waste and Vent Piping

1.2 REFERENCES

A. The PHCC "National Standard Plumbing Code/1993"

B. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use

C. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings

D. ANSI A117.1, Public Law 90-480

E. Where handicap access is required, Contractor shall comply with the more stringent requirements of the guidelines presented below:

1. “ADA Accessibility Guidelines for Buildings and Facilities - Federal Register Vol. 56, No. 144, 7-26-91”

F. Facilities Guidelines Institute - 2018

1.3 SUBMITTALS

A. Product Data - manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors and accessories.

B. Proposed mounting heights for all fixtures. Refer to Architectural Plans and Elevations for all Toilet Room dimensions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.

B. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.

1.5 SEQUENCE AND SCHEDULING

A. Schedule rough-in installations with the installation of other building components.

1.6 EXTRA MATERIALS

A. Furnish special wrenches and other tools and devices necessary for servicing each type of plumbing fixture and trim to owner, with receipt in a quantity of 1 device for 10 fixtures (minimum of 1).

B. Furnish 1 faucet repair kit for each type of faucet, complete with all necessary washers, springs, pins, retainers, packings, O-rings, sleeves, cartridges, and seats (minimum of 1).

PART 2 PRODUCTS

2.1 FIXTURES

A. See Plumbing Fixture Schedule on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Examine rough-in for sample water and waste piping system to verify actual locations of piping connections prior to installing fixtures.

C. Examine walls and floors for suitable conditions where fixtures are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with the provisions in Section 221116 and 221316.

B. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.

C. Comply with the installation requirements of ANSI A117.1 and the handicap access codes referenced in Paragraph 1.03.

D. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.

Install a stop valve in an accessible location in the water connection to each fixture.

E. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.

F. Seal fixtures to walls and floors using silicone sealant as specified in Section 079200. Match sealant color to fixture color.

3.3 FIELD QUALITY CONTROL

A. Test fixtures to demonstrate proper operation upon completion of installation. Replace malfunctioning units, then retest at no additional cost to the Owner.

B. Inspect each installed unit for damage. Replace damaged fixtures.

3.4 ADJUSTING

A. Replace washers of leaking or dripping faucets and stops.

B. Adjust water pressure at faucets, shower valves, and flush valves to provide proper flow and stream.

3.5 CLEANING

A. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.6 PROTECTION

A. Provide protective covering for installed fixtures and trim.

B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by the Owner.

END OF SECTION

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SECTION 230000

BASIC HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes basic HVAC requirements and general conditions.

B. Contractor to provide VFD's and disconnects for all HVAC equipment as shown in equipment schedules and/or equipment specifications.

C. Related Sections

1. Section 011400 – Work Restrictions

2. Section 017700 - Closeout Procedures

1.2 REFERENCES

A. International Building Code – IBC 2021

B. International Mechanical Code – IMC 2021

C. International Energy Conservation Code – IECC 2021

D. Connecticut State Building Code, 2022, Supplements and Amendments.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

1.3 SUBMITTALS

A. Comply with the requirements in Section 01330, Submittal Procedures.

B. Submit manufacturer's drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Submit manufacturer's drawings, bill of material, equipment layouts, catalog data, wiring diagrams and other documentary or descriptive information for each assembly.

1.4 CLOSEOUT PROCEDURES

A. Prior to final acceptance of the Work, provide all closeout documentation in accordance with Section 017700.

1.5 REGULATORY REQUIREMENTS

A. Conform to all codes listed under References in this Section.

B. Conform to all applicable Local Building Codes.

C. Obtain and pay for all applicable permits.

1.6 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner's Project Representative before proceeding.

C. Location of heating, ventilation, and air conditioning equipment, piping and ductwork are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is significantly different from that indicated (greater than 5 feet away from location shown on Drawings), the Owner's Project Representative must give approval to the change.

1.7 WORK RESTRICTIONS

A. Refer to section 011400 Work Restrictions, for restrictions during construction.

1.8 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications are typical of work done and of arrangement desired. Provide all accessories and appurtenances necessary to provide a complete system.

B. Record Drawings: Maintain a master set of record drawings showing the changes and deviations from the contract drawings or the approved shop drawings. Make markups as the changes are made. Submit record documentation to Engineer by substantial completion.

C. Where underground facilities are installed (such as to condensing units), measure, record, and submit final dimensions.

D. The term "Provide" shall mean "To furnish, install, and connect completely".

E. Where the Contractor proposes to use equipment other than that specified in the Contract Documents which requires any redesign of architectural, structural, mechanical, HVAC, plumbing, fire protection, electrical systems or other systems not listed, all redesign efforts and all new drawings and specifications required shall be prepared by the Engineer at the Contractor's expense and are subject to the review and approval of the Owner. Owner reserves the right to have the Architect or Engineer of their choice prepare any redesign work.

1.9 WARRANTY

A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts, and adjustments required due to failure in materials or workmanship within one year from final acceptance of the Work.

B. During this warranty period, Contractor shall answer all service calls at no expense to the Owner. All defects developing through faulty materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Owner's satisfaction.

C. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty is in addition to all other warranties existing under either the Contract Documents or required by Law.

D. Turn over to the Owner all manufacturer's warranties for equipment and materials provided.

1.1 BASES AND SUPPORTS

A. Unless otherwise specifically noted in the Contract Documents, provide all necessary supports required for all equipment furnished under this Division.

B. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

C. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement. The equipment and its supports shall be provided with suitable restraints to resist horizontal movement from any direction as dictated by applicable seismic Codes.

1.2 FIRE – STOPS AND SEALS

A. Fire-stopping systems shall be submitted as shop drawing.

B. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire- stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling, or floor.

C. Thru wall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

D. All piping and conduit penetrations through the roof shall be provided with Pate Type PCA pipe curb assemblies or acceptable equivalent. Coordinate installation details with the roofing system being used for the project.

1.3 ACCESSIBILITY AND PANELS

A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work.

B. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, fans, controllers, coils, terminal equipment, valves, actuators, filters, sensors, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.

C. Access doors in walls, ceilings, floors, etc., shall be provided by the General Contractor. Field coordinate locations and provide information regarding the sizes and quantities of access doors required for their work. Arrange work in such a manner to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.

D. On a clean set of drawings, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect for review before access doors are purchased or installed. Upon approval, coordinate access door locations with the General Contractor.

E. Upon completion of the Project, physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels at no additional cost to the Owner.

1.4 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

PART 2 PRODUCTS

2.1 GENERAL

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes, but not limited to:

1. Balancing Air Systems.
2. Balancing Hydronic Piping Systems.
3. Testing, Adjusting, and Balancing Equipment:
    a. Fans
    b. Motors.
    c. Condensing units.
4. Testing, adjusting, and balancing existing systems and equipment.
5. Duct leakage tests.
6. Measuring electrical performance of HVAC equipment.
7. Verifying control system sequence of operations and coordination with the ATC contractor.

B. Related Sections:

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

H. Adjust - To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

I. Balance - To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

J. Branch - Duct or pipe serving a single terminal.

K. Branch Main - Duct or pipe serving two or more terminals.

L. Main - duct or pipe containing the system's major or entire fluid flow.

M. Procedure - Standardized approach and execution of sequence of work operations to yield reproducible results.

N. Report forms - Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

O. Submain - Duct or pipe containing part of the systems' capacity and serving two or more branch mains.

P. Test - To determine quantitative performance of equipment.

Q. Terminal - The point where the air enters or leaves the distribution system. Examples are air supply diffusers and air return grilles.

1.3 SUBMITTALS

A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

C. Deficiency reports.

D. Certified TAB reports.

E. Floor plans with all test locations circled in bold red marker. Note duct sizes on the floor plans if they differ from the design drawings.

F. Floor plans noting where balancing devices (dampers, etc.) are not installed per the contract documents. Refer to HVAC details for balancing device locations.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.

2. Serial number.

3. Application.

4. Dates of use.

5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. Installing contractor may not test and balance their own work. An independent TAB Contractor is required.

B. TAB Specialists Qualifications: Certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TAB.

2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.5 FIELD CONDITIONS

A. Full or Partial Owner Occupancy: Owner may occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

A. Test and balance airflow for all air handlers affected by scope of work.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems to observe if the installed systems may create adverse effects on airflow or water flow performance. Submit observation Deficiency Report to Engineer and Owner. Do not begin testing, adjusting, and balancing of any systems until deficiencies have been remedied.

C. Examine installed systems for balancing devices, such as manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible. If there are inadequate devices or are not easily accessible, notify project Engineer in writing.

D. Examine the approved submittals to obtain flow rates and balancing values for HVAC systems and equipment.

E. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, statements of philosophies and assumptions about HVAC system and equipment controls, and sequences of operations.

F. Verify that penetrations in plenum walls are sealed and fire-stopped if required. If any deficiencies exist, notify project Engineer in writing.

G. Examine equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

a. Document locations in systems where system effects may cause undesired conditions. Submit locations to project Engineer.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use

tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

H. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

I. Examine test reports specified in individual system and equipment Sections.

J. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report deficiencies discovered before and during performance of TAB procedures to project Engineer. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values. Report if no deficiencies are discovered.

3.3 PREPARATION

A. Prepare a complete TAB plan that includes the following:

1. Equipment and systems to be tested.

2. All sequences to be tested.

3. Strategies and step-by-step procedures for balancing the systems.

a. Note minimum and maximum duct traverse test points and test point distance spacing for varying duct sizes.

4. Instrumentation to be used.

5. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Duct systems are complete with terminals installed.

b. Volume, smoke, and fire dampers are open and functional.

c. Clean filters are installed.

d. Fans are operating, free of vibration, and rotating in correct direction.

e. Automatic temperature-control systems are operational.

f. Ceilings are installed.

g. Windows and doors are installed. All windows shall be shut and locked. All exterior doors shall be shut, with only normal traffic in and out. All

interior doors in rooms served by systems being tested shall be closed and remain closed for the duration of the test.

h. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance"

B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch and seal probe holes in ducts with same material and thickness as used to construct ducts.

2. Install, join, and seal new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230700 “HVAC Insulation”.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in the “Ducts" specification.

L. Adjust or change fan and motor sheaves, pulleys and belts to properly balance the system.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. The procedures in this article apply to constant volume supply, return, and exhaust air systems.

B. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and exhaust-air dampers for proper position that simulates minimum outdoor-air conditions.

b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

e. Set and measure other outside-air, return air, and exhaust air dampers for proper position that simulates other outdoor air conditions as specified in the sequence of operations.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.

b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.

d. Measure outlet static pressure as far downstream from the fan as practicable, at least three-quarters of the way down the system.

e. Report artificial loading of filters at the time static pressures are measured.

3. Obtain approval from Engineer or Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.

2. Adjust submain and branch duct volume dampers for specified airflow.

3. Re-measure each submain and branch duct after all have been adjusted.

D. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure inlets and outlets airflow.

3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after they have been adjusted.

E. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Re-adjust to design if necessary.

2. Re-measure and confirm that total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.

4. Mark all final settings.

5. Measure and record all operating data.

6. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.

2. Motor horsepower rating.

3. Motor rpm.

4. Phase and hertz.

5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.

7. Starter size and thermal-protection-element rating.

8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.

2. Dry-bulb temperature of entering and leaving air.

3. Wet-bulb temperature of entering and leaving air for cooling coils.

4. Airflow.

5. Air pressure drop.

B. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.

2. Wet-bulb temperature of entering and leaving air.

3. Airflow.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.

2. Coils are clean and fins combed.

3. Strainers are clean.

4. Drain pans are clean.

5. Fans are clean.

6. Bearings and other parts are properly lubricated.

7. Deficiencies noted in the preconstruction report are corrected.

B. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan existing airflows, and determine the new fan speed and the face velocity of filters and coils.

2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.10 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Air Systems:

a. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to +10 percent.

b. Air Outlets and Inlets: +/- 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.11 FINAL REPORT

A. General: Prepare a certified computer written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves – where available.

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB specialist.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:

a. Design versus final performance. Design values shall be recorded from the approved equipment submittals.

b. Notable characteristics of systems, including suspect duct, piping, and equipment installations causing high system pressure drop.

c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Data for terminal units, including manufacturer's name, type, size, and fittings.

14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans and pump performance forms including the following:

a. Settings for outdoor-, return-, and exhaust-air dampers.

b. Conditions of filters.

c. Cooling coil, wet- and dry-bulb conditions.

d. Fan drive settings including settings and percentage of maximum pitch diameter.

e. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Duct, outlet, and inlet sizes.

3. Balancing stations.

4. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.

b. Location.

c. Make and type.

d. Model number and unit size.

e. Manufacturer's serial number.

f. Unit arrangement and class.

g. Discharge arrangement.

h. Sheave make, size in inches, and bore.

i. Center-to-center dimensions of sheave and amount of adjustments in inches.

j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.

f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Designed and Actual Values):

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Filter static-pressure differential in inches wg.

f. Cooling-coil static-pressure differential in inches wg.

g. Heating-coil static-pressure differential in inches wg.

h. Outdoor airflow in cfm.

i. Return airflow in cfm.

j. Outdoor-air damper position.

k. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.

b. Location.

c. Coil type.

d. Number of rows.

e. Fin spacing in fins per inch o.c.

f. Make and model number.

g. Face area in sq. ft.

h. Tube size in NPS.

i. Tube and fin materials.

j. Circuiting arrangement.

2. Test Data (Designed and Actual Values):

a. Airflow rate in cfm.

b. Average face velocity in fpm.

c. Air pressure drop in inches wg.

d. Outdoor-air, wet- and dry-bulb temperatures in deg F.

e. Return-air, wet- and dry-bulb temperatures in deg F.

f. Entering-air, wet- and dry-bulb temperatures in deg F.

g. Leaving-air, wet- and dry-bulb temperatures in deg F.

h. Refrigerant expansion valve and refrigerant types.

i. Refrigerant suction pressure in psig.

j. Refrigerant suction temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Arrangement and class.

g. Sheave make, size in inches, and bore.

h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

g. Number, make, and size of belts.

3. Test Data (Designed and Actual Values):

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.

b. Location and zone. Note location on floor plans.

c. Traverse air temperature in deg F.

d. Quantity of traverse reading points for each test location.

e. Duct static pressure in inches wg.

f. Duct size in inches.

g. Duct area in sq. ft.

h. Indicated airflow rate in cfm.

i. Indicated velocity in fpm.

j. Actual airflow rate in cfm.

k. Actual average velocity in fpm.

l. Barometric pressure in psig.

I. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.12 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner, Architect, Engineer, Construction Manager, or commissioning authority.

B. Owner, Architect, Engineer, Construction Manager, or Commissioning authority will randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

3. If the second verification also fails, Owner, Engineer, or Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

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SECTION 230700

HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Ductwork Insulation:

a. Fiberglass.

2. Field applied jackets.

B. Related Sections

1. Section 233100 – HVAC Ducts and Casings

1.2 REFERENCES

A. ASTM C 547 - Specification for Mineral Fiber Preformed Pipe Insulation.

B. ASTM C 553 - Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type).

C. ASTM C 612 - Specification for Mineral Fiber Block and Board Thermal Insulation.

D. ASTM C 921 - Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

E. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.

B. Installers' Qualifications - Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for the project.

C. Flame/Smoke Ratings - Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer - Subject to compliance with requirements, provide products of one of the following:

1. Knauf Fiber Glass GmbH.
2. Manville Products Corp.
3. Owens-Corning Fiberglass Corp.
4. Childers Products Co.
5. Specialty Products and Insulation Co.
6. Or equal

2.2 MATERIALS

A. HVAC Ductwork Insulation

1. Rigid Fiberglass Ductwork Insulation - ASTM C 612, Class 1.
2. Flexible Fiberglass Ductwork Insulation - ASTM C 553, Type I, Class B-4.
3. Jackets for Ductwork Insulation - ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.
4. Ductwork Insulation Accessories - Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
5. Ductwork Insulation Compounds - Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. HVAC Ductwork

1. Insulate the following ductwork and accessories:

a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.

b. Exhaust air ductwork between exterior penetration and backdraft damper, or motor operated damper.

c. All interior HVAC supply air ductwork.

d. Insulate neck and bells of diffusers, grilles, and registers.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Indirectly conditioned, such as above suspended ceilings but within the same floor as conditioned spaces: R-4

b. Unconditioned spaces within the thermal envelope: R-8

c. Ductwork and duct plenums located in unconditioned spaces: Fiberglass to R-8

d. Ductwork and duct plenums located within the building envelope assembly: Fiberglass to R-12

3.2 INSTALLATION

A. General

1. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Ductwork Insulation

1. Install insulation materials with smooth and even surfaces.

2. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

3. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage.

4. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

5. Lined Ductwork - prohibited.

6. Corner Angles - Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.3 REPAIR/RESTORATION

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units, at no additional cost to the Owner.

3.4 PROTECTION

A. The Contractor shall provide the required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

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SECTION 233100

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Metal Ductwork
2. Sealants and Gaskets
3. Hangers and Supports

B. Related Sections

1. Section 230700 - HVAC Insulation
2. Section 233300 - Ductwork Accessories

1.2 REFERENCES

A. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) for the Hot-Dip Process

1.3 SUBMITTALS

A. Product data and installation instructions for materials and products.

B. Scaled layout drawings of ductwork and fittings including but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how these modifications ensure that free area, materials and rigidity are not reduced. Provide a legend defining all abbreviations used.

C. Maintenance data and parts lists for ductwork materials and products.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of metal products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.

B. Installer's Qualifications - Firm with at least 3 years of successful installation experience on projects with metal systems similar to that required for project.

C. Codes and Standards

1. SMACNA Standards - Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

2. ASHRAE Standards - Comply with ASHRAE Handbook, HVAC Systems and Equipment, Chapter 16 "Duct Construction", for fabrication and installation of ductwork.

3. NFPA Compliance - Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

D. Field Reference Manual - Have available for reference at project field office, copy of the following references:

1. SMACNA "HVAC Duct Construction Standards, Metal and Flexible."

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 PRODUCTS

2.1 METAL DUCTWORK

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Steel Ducts: Comply with ASTM A653/A 653M.

1. Galvanized coating designation: G90 zinc coated

2. Finishes for surfaces exposed to view: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 METAL DUCTWORK MATERIALS

A. General - Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings - Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.

C. Flexible Ducts - Either spiral-wound spring steel with flame-proof vinyl sheathing, or corrugated aluminum; complying with UL 181.

1. Where installed in unconditioned spaces other than return air plenums, provide 2 inch thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

2.3 METAL DUCT FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards). Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

F. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, or mastic plus embedded fabric systems.

1. Sealants and Mastics: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.

2. Tape is not acceptable.

G. Sealing products shall bear UL approval markings.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.

4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Tape type sealants are not acceptable.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods: Hot-dipped galvanized G60 steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Hot-dipped galvanized steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

G. Beam clamps: hot-dipped galvanized steel with set screw and lock nut. Use jam nut with threaded rod. Spring steel snap-on or hammer-on type are not acceptable.

PART 3 EXECUTION

3.1 INSPECTION

A. General - Examine areas and conditions under which ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 DUCTWORK SCHEDULE:

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Duct material: All ductwork shall be galvanized steel. Static Pressure Class: Unless noted otherwise, construct ducts according to the following:

1. Ducts connected to fan coil units, furnaces, heat pumps, and terminal units:

a. Supply Ducts (Positive Pressure): 2-inch w.g.

b. Return Ducts (Negative Pressure): 2-inch w.g.

c. Outdoor-air Ducts: (Negative Pressure): 2-inch w.g.

2. Exhaust Ducts (Negative Pressure):

a. Ducts exhausting ASHRAE 62.1 Class 1 and 2 air: 2" w.g.

3.3 INSTALLATION OF DUCTWORK

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3 inches w.c. and under) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connection, within 1/2 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

E. Support design and installation shall be in accordance with applicable Connecticut Building Codes.

F. Field Fabrication - Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

G. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system

H. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations, or, if not otherwise indicated, run ductwork in shortest route which

does not obstruct useable space or block access for servicing building and its equipment.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Install ducts close to walls, overhead construction, and other structural and permanent enclose elements of building.

K. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

L. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

M. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

N. Install fire dampers where shown on drawings. Comply with requirements in Section 233300 “Ductwork Accessories” for fire and smoke dampers.

O. For penetrations in fire rated walls and ceilings, provide fire dampers and fire stops to maintain the fire rating of the wall or ceiling. For penetrations in non-fire rated ceilings, provide fire blocking around the ducts.

P. Coordination - Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

Q. Ductwork Insulation – Insulate ductwork in accordance with Section 230700.

3.4 EQUIPMENT CONNECTIONS

A. General - Connect ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated, or as required to provide access for cleaning ducts.

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. All ducts shall be “Seal Class A”.

3.6 HANGERS AND SUPPORTS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hanger Spacing: Comply with SMACNA's "Fibrous Glass Duct Construction Standards," Table 6-1, "Maximum Hanger Spacing by Duct Size ID," for maximum hanger spacing.

E. Hangers Exposed to View: Threaded rod and angle or channel supports.

F. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

G. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used

3.7 FIELD QUALITY CONTROL

A. Visually inspect duct system to ensure that no visible contaminants are present

B. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

C. Provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris at ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation.

D. Seal any leaks in ductwork that become apparent in balancing process.

E. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

1. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

F. Duct system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris

END OF SECTION

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SECTION 233300

DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Volume dampers
2. Turning vanes
3. Duct hardware
4. Duct access doors
5. Flexible connections
6. Flexible ducts

B. Related Sections

1. Section 230700 - HVAC Insulation
2. Section 233100 – HVAC Ducts

1.2 QUALITY ASSURANCE

A. Manufacturers' Qualifications - Firms regularly engaged in the manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Code and Standards:

1. SMACNA Standards - Comply with SMACNA’s “HVAC Duct Construction Standards, Metal and Flexible” for fabrication and installation of metal ductwork.
2. Industry Standards - Comply with ASHRAE recommendations pertaining to construction of ductwork, accessories, except as otherwise indicated.
3. NFPA Compliance - Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.3 SUBMITTALS

A. Technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Manufacturer's maintenance data including parts lists for each type of duct accessory.

PART 2 PRODUCTS

2.1 VOLUME DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Splitter and Single Blade Dampers:

1. Material: Same material and gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single or double thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

4. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.

D. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.

E. Quadrants:

1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches furnish regulator at both ends.

F. Manufacturer - Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.

2. Airguide Corp.

3. Louvers & Dampers, Inc.

4. McGill Airflow Corp.

5. Nailor Industries

6. Penn Ventilator Co.

7. Ruskin Mfg. Co.

8. Or equal

2.2 TURNING VANES

A. Manufactured Turning Vanes - Provide turning vanes constructed in accordance with SMACNA requirements.

B. Turning vanes shall be an engineered, true airfoil design with smoothly-rounded entry nose and extended trailing edge for high efficiency performance.

C. Fabricate assemblies with side rail support system. Install vanes 2.4" on center across the full diagonal dimension of the elbow. Secure each vane with ring shank screws, two on each end for no-rattle assembly. Tabbed or slotted dimple fasteners are not acceptable.

D. Metal vane and rail material: Same material as duct.

E. Manufacturer - Subject to compliance with requirements, provide turning vanes by one of the following:

1. Aero-Dyne Sound Control Co.

2. General Insulation Company, Inc.

3. Ductmate Industries, Inc.

2.3 DUCT HARDWARE

A. General - Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes - Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

2. Quadrant Locks - Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 inches. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer - Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.

2. Young Regulator Co.

3. United Sheet Metal

4. Or equal

2.4 DUCT ACCESS DOORS

A. General - Provide where indicated or required, duct access doors of size indicated.

B. Construction - Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle-type latch for doors 12 inches high and smaller, 2 handle-type latches for larger doors. Material of construction shall match ductwork.

C. Manufacturer - Subject to compliance with requirements, provide duct access doors of one of the following:

1. Air Balance, Inc.
2. Duro Dyne Corp.
3. Register & Grille Mfg. Co., Inc.
4. Ruskin Mfg. Co.
5. Ventfabrics, Inc.
6. Zurn Industries, Inc.; Air Systems Div.
7. Or equal

D. Manufacturer - Subject to compliance with requirements, provide flexible connections of one of the following:

1. American/Elgen Co., Energy Div.
2. Duro Dyne Corp.
3. Flexaust (The) Co.
4. Ventfabrics, Inc.
5. Or equal

2.5 FLEXIBLE DUCTS

A. Product Description: UL 181, Class 1, two ply vinyl film supported by helical wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.

1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
2. Maximum Velocity: 4000 fpm.
3. Temperature Range: -10 degrees F to 160 degrees F.
4. Thermal Resistance:

a. Indirectly conditioned, such as above suspended ceilings but within the same floor as conditioned spaces: R-4

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.

C. Flexible ducts shall only be used to connect rigid ducts to equipment and shall not exceed three feet in length.

D. Access Doors

1. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter. Install at the following locations,

a. Spaced every 50 feet of straight duct.

b. Upstream of each elbow.

2. Access Door Sizes:

a. Square Ducts: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

b. Round Ducts: Install minimum 8 inches in diameter for hand access, 18 inch for head and shoulder access, 24 inches for body access, and as indicated on Drawings.

E. Provide volume dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Sheet metal contractor shall install all motorized control dampers.

G. Provide test holes at fan inlets and outlets and elsewhere as required for testing and balancing purposes.

H. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING

A. Adjusting - Adjust ductwork accessories for proper settings.

1. Label access doors in accordance with Division 23 section "Mechanical Identification".

2. Final positioning of manual dampers is specified in Division 23 section "Testing, Adjusting, and Balancing".

B. Cleaning - Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

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SECTION 233717

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Duct registers and grilles

2. Ceiling Air Diffusers and Grilles.

3. Wall Registers.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards

1. ARI Compliance - Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance - Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. ADC Compliance - Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

4. ADC Seal - Provide air outlets and inlets bearing ADC Certified Rating Seal.

5. NDPA Compliance - Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

A. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

B. Data sheets for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, mounting details and warranty.

C. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

D. Manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

E. Maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Diffusers, Registers, & Grilles

1. Price Industries
2. Krueger
3. Titus Products Div
4. Metal-Aire
5. Or equal

2.2 CEILING AIR DIFFUSERS AND GRILLES

A. General - Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated.

B. Performance - Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Fabrication: Steel, extruded aluminum or stainless steel with baked enamel finish. Refer to Diffuser Schedule for material. Color shall be selected by Architect or Owner.

D. Ceiling Compatibility - Provide diffusers and grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to Drawings for types of ceiling systems which will contain each type of ceiling air diffuser.

E. Provide factory built square to round transition, where required.

2.3 WALL REGISTERS

A. General - Except as otherwise indicated, provide manufacturer's standard wall registers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated.

B. Performance - Provide wall registers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Wall Compatibility - Provide registers with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to Drawings for types of wall construction which will contain each type of wall register.

D. Types - Provide wall registers of type, capacity, and with accessories and finishes as listed on register schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register Materials

    a. Aluminum Construction - Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Register Faces

    a. Horizontal Straight Blades - Horizontal blades, individually adjustable, at manufacturer's standard spacing.

    b. Vertically Straight Blades - Vertical Blades, individually adjustable, at manufacturer's standard spacing.

3. Register Patterns

    a. Double Deflection - 2 sets of blades in face, rear set at 90 degrees to face set.

4. Register Dampers

    a. Opposed Blade - Adjustable opposed blade damper assembly, key operated from face of register.

5. Register Accessories

    a. Extractor - Curved blades mounted on adjustable frame to produce air scooping action in duct at register take-off.

    b. Operating Keys - Tools designed to fit through register face and operate volume control device and/or pattern adjustable.

6. Register Finishes

    a. Aluminum Anodize - Aluminum etched and anodized, covered with clear lacquer finish.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General - Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

END OF SECTION

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SECTION 260500

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Basic Electrical Requirements specifically applicable to Division 26 Sections
2. As-Built Documentation

B. Related Sections

1. Section 011400– Work Restrictions
2. Section 017700- Closeout Procedures
3. Section 260800 - Electrical Testing

1.2 REFERENCES

A. ASCE 7-10 – Minimum Design Loads for Buildings and Other Structures

B. International Building Code – IBC 2021

C. Connecticut State Building Code

D. NFPA 70 - National Electrical Code

E. NFPA 99 - Health Care Facilities Code

F. Facilities Guidelines Institute -2018

1.3 SUBMITTALS

A. Submit shop drawings, product data, and reports.

B. Submit as-built documentation in accordance with Section 01770.

C. Submit a written warranty.

D. Seismic restraint details including stamped certification from a professional engineer.

E. Provide a schedule of all Electrical system related Owner training, within one month of the Notice to Proceed. Prior to training, resubmit schedule if training is rescheduled and resubmit upon completion of all training. At a minimum, for each piece of equipment or system to be demonstrated, the schedule should include the following:

1. Equipment or system to be demonstrated
2. Related specification section
3. Anticipated date of training
4. Anticipated duration of training session
5. Name and company of instructor providing the training
6. Date completed

7. Actual duration of training session

F. Submit a Sequence of Construction for the demolition and installation of equipment with restrictions listed in this document and 011400. Sequence of Construction shall be updated during construction (if changes are required) and resubmitted for comment.

1.4 REGULATORY REQUIREMENTS

A. Electrical - Conform to the state-adopted version of the National Electrical Code

B. Conform to applicable Local Building Codes.

C. Obtain and pay for all applicable permits.

D. Schedule and pay for all inspections necessary for the electrical installation including but not necessarily limited to the general electrical inspection and fire department inspections.

1.5 PROJECT CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Engineer before proceeding.

C. Location of electrical equipment, devices, and similar items, as indicated, are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is different from those indicated (greater than 5 feet away from location shown on Drawings), the Engineer must give approval to the change.

D. Verify in field, existing conditions and final locations of equipment installed under other Sections that require electrical work.

E. Where it is necessary to core a hole through an existing concrete slab or wall, the Contractor shall conduct a survey with a pachometer or by similar means to identify the location of steel reinforcing bars. The new hole shall be located so as to avoid cutting reinforcing bars. Where reinforcing steel is close enough together that it is not possible to core the required hole without cutting reinforcing bars, contact the Engineer for further direction before cutting a hole. Where reinforcing bars are cut without the consent of the Engineer, the slab or wall will be repaired at the expense of the Contractor.

F. Equipment wiring

1. Equipment power and control wiring is based on specific manufacturers and models. Actual wiring required may be different.

2. Before pulling any power or control wire or installing conduit, obtain equipment electrical and control installation instructions and wiring diagrams. Any discrepancies from what is shown on the electrical drawings shall be brought to the attention of the Engineer. The Engineer will provide instructions for any changes that may be necessary.

3. Installation of conduit or wire prior to obtaining the above specified information shall be at the Contractor's risk. The Owner will not be responsible for any extra costs related to removal or replacement of conduit or wire resulting from the failure to coordinate equipment conduit and wire requirements. In the event that additional conductors or larger conductors than shown on the Drawings are

required, the Owner will not be responsible for any labor costs related to the installation of these materials unless it can be demonstrated by the Contractor to the satisfaction of the Engineer that these conductors could not have been installed at the same time as the conductors shown on the Drawings.

G. Drawings and Specifications

1. Drawings and Specifications are typical of work done and of arrangement desired. Provide accessories and appurtenances necessary for complete installation (e.g., home runs, conduit and wire for instrumentation and control wiring) that are required to provide a complete electrical system.

H. As-Built Drawings: Maintain a master set of as-built drawings showing the changes and deviations from the Drawings or the approved shop drawings. Make markups as the changes are made.

I. Where underground electric facilities are installed, measure, record, and submit as built dimensions.

1.6 SEQUENCING AND SCHEDULING

A. Shutdown quantity and durations shall be minimized and limited to restrictions specified in 011400 Work Restrictions and as described below.

B. Provide temporary power source(s), motor controller(s), distribution equipment, wiring (power and signal) and conduit as required to keep all equipment operational at all times (except during switchovers), to meet requirements of 011400 Work Restrictions, and to meet requirements described below.

C. Coordinate shutdown schedule and durations with the Owner. Give the Owner at least 1 week advanced notice before shutdowns.

D. Install all conduit/wire to the extent feasible prior to shutdowns to minimize outage durations.

1.7 WARRANTY

A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts and adjustments required due to failure in materials or workmanship within one year from final acceptance of the Work.

B. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty is in addition to all other warranties existing under either the Contract Documents or required by Law.

1.8 SEISMIC REQUIREMENTS

A. Components, systems and their supports shall be designed by the contractor in accordance with ASCE 7-10, Section 13.6 Mechanical and Electrical Component Design, the 2018 Connecticut State Supplement to the 2015 edition of the International Building Code (IBC 2015).

B. Submit details showing the seismic restraints.

C. Submit stamped, signed certification from a Connecticut licensed professional structural engineer that the design meets the seismic restraint requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Products shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA if a listing for that product is available. NRTL shall be Underwriter's Laboratory (UL), Electrical Testing Laboratory (ETL), Factory Mutual (FM) or equal.

B. Equipment Ampere Interrupting Capacity (AIC) and/or Short Circuit Current Rating (SCCR): Electrical equipment shall be labeled in accordance with NFPA 70 and have an Ampere Interrupting Capacity rating or Short Circuit Current Rating of equal to or greater than the following:

1. 208 or 240 volt equipment: 10,000 amps

2.2 FINAL SYSTEM DOCUMENTATION

A. Prior to final acceptance of the system, provide operating and maintenance manuals (O&M's) covering instruction and maintenance on each type of equipment in accordance with Section 01770.

B. The requirements for final documentation shall be as specified in Section 01770.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform all work in accordance with OSHA (Occupational Safety and Health Administration) requirements.

B. Perform all work in accordance with NFPA 70E, Handbook for Electrical Safety in the Workplace.

C. Install all equipment in accordance with manufacturer's instructions and recommendations.

D. Test all electrical components in accordance with Section 260800 and as indicated in individual electrical equipment specification sections.

E. Perform all electrical equipment installation, checkout, and test in a safe manner. Provide the following special safety precautions, as appropriate:

1. Locking and tagging procedures
2. Barricades
3. De-energization and/or isolation of equipment prior to testing
4. Review of procedures with the Engineer and the Owner
5. Erection of warning signs
6. Stationing of guards and watchmen
7. Maintenance of voice communications
8. Personnel orientation

F. Do not install electrical equipment in its permanent location until structures are weather-tight or equipment is properly protected from the weather.

G. Before energizing any machine, visually inspect for serviceability. Verify that equipment and machines have been properly lubricated and aligned. Verify nameplate for electrical power requirements.

H. Contractor shall provide a label on each of the following types of equipment that indicates the maximum available short circuit current at that equipment. Obtain available short circuit current values from engineer during construction. Unless values shown on drawings, Contractor shall request values from Engineer at least 4 weeks prior to starting up equipment.

1. Switchboards
2. Switchgear
3. Panelboards
4. Equipment that is required to be marked with a short circuit current rating, such as motor controllers and industrial control panels of multi-motor and combination load equipment.

END OF SECTION

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SECTION 260505

MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Electrical demolition

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: as specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on field observation and existing record documents. Report discrepancies to the Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary power source(s), wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

C. Existing Electrical System: Disable system only to make switchovers and connections. Obtain permission from Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Verify permission to disable with the Owner immediately before the work. See 16050 and 01140 for additional requirements.

D. Existing Fire Alarm System: Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, boxes, supports and fasteners, including above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Voids created by the removal of conduit in floors or walls above or below ceilings shall be patched and sealed with materials matching the existing construction.

F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Repair adjacent construction and finishes damaged during demolition and extension work with materials matching the existing construction.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangements. Provide engraved nameplates identifying panelboard, supply voltage, phase and power source.

3.5 INSTALLATION

A. Install relocated materials and equipment as indicated.

END OF SECTION

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SECTION 260519

CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Building wire and cable
2. Metal clad (MC) cable
3. Wire connectors

B. Related Sections

1. Section 260553- Electrical Identification

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

B. NFPA 99 - Health Care Facilities Code

C. Facilities Guidelines Institute -2018

1.3 SUBMITTALS

A. Submit shop drawings, product data and reports.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.5 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Determine required separation between cable and other work.

C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Description: Stranded conductor insulated wire, multi-conductor control cable and tray cable.

B. Conductor: copper

C. Insulation Voltage Rating: 600 volts

D. Insulation Temperature Rating: 90°C

E. Insulation: ANSI/NFPA 70; all power and control wiring shall be XHHW-2 unless otherwise indicated in this specification.

F. Manufacturer

1. Okonite Co.

2. Rome Cable Corp.

3. American Insulated Wire Corp.

4. Southwire

5. or equal

2.2 METAL CLAD (MC) CABLE

A. Uses Permitted

1. MC cable may be utilized in lieu of conduit and cable in dry, hollow partitions and ceiling cavities for general purpose, 20 ampere, single phase, 120 or 277 volt, normal branch circuits for receptacles and lighting fixtures only.

2. HCF and HFC Luminary cable may be utilized in lieu of conduit and cable in dry, hollow partitions and ceiling cavities for general purpose, 20 ampere, single phase, 120 volt, normal branch circuits for receptacles and lighting fixtures in patient care areas.

3. For branch circuit homeruns to surface mounted panels, MC and HCF cable shall terminate in a junction box 5'-0" (minimum) horizontally away from the panel. If panelboards are located in rooms designated as electric rooms, mechanical rooms or closets, MC cable shall terminate in a junction box outside of the room or closet and conduit shall be run to the panel.

4. MC and HCF cable shall not be used in electrical, mechanical or plumbing rooms, closets or shafts, including mechanical platform areas.

5. MC and HCF Cable shall be run continuous without splices from the source to the first load and then from load to load. Intermediate splice points shall be prohibited except where noted otherwise.

B. Conductor Construction

1. Conductors shall be minimum #12 AWG, soft drawn 98% conductive copper with 90°C (Dry Location), 75°C (Wet Location), THHN, 600 volt rated insulation. Included with each length of MC cable shall be the required number of phase conductors (maximum 3), white neutral conductor(s) and an insulated full-size green grounding conductor. Luminary control cables shall be 16-2 AWG Solid TFN Twisted Pink Jacketed Pair (Purple/Pink).

2. Each conductor, including ground conductor, shall be wrapped with nylon covering.

3. Multi-conductor cables shall not have shared neutrals or shared grounds. Provide cable with one neutral and ground per phase conductor when serving multiple branch circuits in a multiconductor cable.

4. Armored clad cable conductors shall be color coded, continuous insulation, as specified above.

C. Exterior Armor Construction

1. The exterior sheath of MC and HCF cables shall be manufactured of galvanized steel armor.

2. The exterior sheath of HCF cable and HCF luminary cable used in patient care areas shall be manufactured of galvanized steel armor and contain an interlocked galvanized steel strip to provide a redundant ground path required by NEC Article 517 for Healthcare Facilities. Exterior cable sheath shall be color-coded green galvanized steel armor with phase ID painted directly onto the armor for added identification without the added step of opening up the panel to determine circuit type.

3. When used in damp or wet locations the armor shall be wrapped at the factory with a PVC jacket.

D. Fittings

1. Fittings for MC cable shall be suitable for use with the appropriate cable assembly.

2. All HCF cables shall be terminated with fittings specifically listed for use with HCF cable.

3. Provide redhead insulators on both ends of the armor of type MC and HCF cables before terminating the cable onto a fitting.

4. Include manufacturer's literature with shop drawings stating application compatibility with each cable type.

5. Fittings shall be as manufactured by Bridgeport, Electroline, OZ Gedney, Thomas and Betts, Emerson, ETP, Regal or equal.

E. Manufacturer

1. Atkore

2. Allflex

3. Alliance

4. Or equal

2.3 ETHERNET CABLE

A. Description: NEC CMR cable, Category 6 unbonded-pair cable

B. Construction: 23 AWG solid bare copper, 4 twisted pairs, overall shield, drain wire, RJ-45 compatible, non-plenum, polyolefin (PO) or PO+FEP insulation, PVC jacket.

C. Manufacturer

1. Belden 2412F

2. Approved equal by Alpha

3. Approved equal by Quabbin

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Minimum size for power wiring shall be AWG #12.

B. Minimum size for control wiring shall be AWG #14.

C. All wiring shall be run in conduit, unless otherwise noted.

D. Install products in accordance with manufacturers' instructions.

E. Use solid wire up to #10AWG and stranded conductors for all other wire sizes.

F. In raceways, mechanically complete the installation in all details. Pull all conductors into raceway at same time.

G. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

H. Protect exposed cable from damage.

I. Support cables above accessible ceiling, using spring metal clips J-hooks or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.

J. Use suitable cable fittings and connectors.

K. Neatly train and lace wiring inside boxes, equipment, and panelboards.

L. Clean conductor surfaces before installing lugs and connectors.

M. Instrumentation, control and signal wiring shall be continuous with no splices from source to destination, unless otherwise shown on drawings.

N. Splices

1. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

2. Properly connect and insulate shields at all splice points.

3. Underground Splices or Splices called out to be Submersible

    a. Provide Polaris Submersible Splice Connectors or equal one-piece system by Burndy, Blackburn or equal.

    b. Underground splices shall be made in a handhole or manhole provided by the contractor and sized per the NEC.

4. Above grade splices

    a. 8 AWG and Larger: Use split bolt connectors for copper conductor splices and taps. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

    b. 10 AWG and smaller: Use insulated spring wire connectors with plastic caps for copper conductor splices and taps.

5. Above ground splices wire reducer

    a. When wire size has been increased to account for derating and/or voltage drop, provide an In-Line Standard Barrel Reducer Splice Kit to reduce the wire down to the size necessary to terminate at the circuit breaker, disconnect, equipment, etc.

    b. The reduced wire shall be sized by the contractor per NEC Table 310.15(B)(16) using the 60^0C Column. The wire shall be sized according to the upstream over current protective device size.

    c. The splice kit shall contain clear heat shrink tube to protect the butt splice.

    d. Tape splice with electrical tape to 150 percent of insulation rating of conductor.

    e. The Reducer splice kit shall be:

        1) Butt splice compression type with inspection window.

        2) Tin plated Copper

        3) Provide Burndy Hyreducer or equal by Blackburn, Polaris or equal.

O. Ground signal cable shields on receiving end only.

P. Provide Kellems grips for all cord connected devices.

Q. Provide separation of power wiring from control and signal wire in accordance with NEC Article 725.

R. Install Ethernet cables in accordance with manufacturers' instructions and industry standards for category 6 wiring.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 260553.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.5 FIELD QUALITY CONTROL

A. Inspect wire and cable for physical damage and proper connection.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

C. Verify continuity of each branch circuit conductor.

END OF SECTION

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SECTION 260526

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Power system grounding
2. Electrical equipment and raceway grounding and bonding
3. Grounding of piping, tanks, handrails and other conductive equipment
4. Communication system grounding
5. Grounding electrode system three-point test (to be performed by a third-party NETA-certified testing company)

B. Related Sections

1. Section 260800 – Electrical Testing

1.2 REFERENCES

A. NFPA 70 – National Electrical Code

B. NFPA 99 – Standards for Health Care Facilities

C. UL 467 - Grounding and Bonding Equipment

D. UL 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors

E. UL 1059 – Terminal Blocks

F. IEEE/ANSI 142 – Latest Edition Recommended Practice for Grounding of Industrial and Commercial Power Systems.

G. ASTM B3 - Solid Conductors

H. ASTM B8 – Assembly of Stranded Conductors

I. ASTM B33 – Tinned Conductors

J. NEMA GR1 – Ground Rods and Ground Rod Couplings

1.3 SYSTEM DESCRIPTION

A. Ground the electrical service system neutral and ground bus at the utility service entrance equipment to grounding electrodes. Grounding electrode system shall include a minimum of three driven ground rods, the underground water service pipe, fire protection service pipe and the metal frame of the building (if effectively grounded). Run exposed grounding electrode conductors in conduit.

B. Ground each separately derived system neutral to the nearest effectively grounded building structural steel member or, if such is not available, to the nearest grounding electrode other than a water pipe.

C. Provide communications systems grounding conductor at point of service entrance and connect to nearest effectively grounded building structural steel member or, if such is not available, to the nearest grounding electrode other than a water pipe.

D. Bond together exposed non-current carrying metal parts of electrical equipment, handrails, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, metallic tanks and all metallic piping.

E. Install grounding in accordance with NEC Article 250.

1.4 SUBMITTALS

A. Submit shop drawings, product data, and reports.

B. Indicate layout of ground rods, location of system grounding electrode connections, and routing of grounding electrode conductor.

C. Submit ground resistance testing reports in accordance with Section 260800.

PART 2 PRODUCTS

2.1 MATERIALS

A. Grounding Electrode Conductors

1. Type: Soft drawn bare copper

2. Manufacturer

a. Okonite Co.

b. Rome Cable Corp.

c. American Insulated Wire Corp.

d. Southwire

e. or equal

B. Grounding Conductors - insulated copper, minimum size #12 AWG and in accordance with NEC Tables 250.66, 250.102(C)(1) and 250.122, or larger if so indicated on the Drawings

C. Ground Rods: Copper-clad steel, ¾inch diameter, minimum length 10 feet

D. Connectors - Mechanical

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of silicon bronze and supplied as part of the connector body and shall be two bolted pressure types.

3. The connectors shall meet or exceed UL467 and be clearly marked with the catalog number, conductor size and manufacturer.

a. Manufacturer

1) ABB Blackburn Installation Products

2) Burndy

3) Ilsco

4) Or equal

E. Connectors - Compression

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. Irreversible compression connectors that meet or exceed the performance requirements of IEEE837, UL467 latest revisions. Compression connectors shall be listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and specific types, sizes and combinations of conductors and other items connected.

3. The irreversible compression connectors shall be manufactured of from pure wrought copper.

   a. The installation of the connectors shall be made with a hydraulic compression tool and die system clearly showing embossed die stamp on each crimp as recommended by the manufacturer of the connectors

   b. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size

   c. Each connector shall be factory filled with an oxide – inhibiting compound where applicable.

4. Manufacturer

   a. ABB Blackburn Installation Products

   b. Burndy

   c. Ilsco

   d. Or equal

F. Connectors - Welded

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. Exothermic welded connections for copper to copper and copper to steel connections to ground rods, ground buses, ground wires, steel beams etc.

3. Conductors spliced with exothermic welded connections shall be considered as a continuous conductor, as stated in the noted accompanying NEC Article 250.50, 250.64 and IEEE Standard 80 latest edition.

   a. Procedures outlined in the manufacturer's installation instructions shall be followed. Molds shall not be modified during installation in field applications

   b. Weld metals shall be a mixture of copper oxide and aluminum. Only one weld metal mixture shall be required for each grounding connection.

c. Grounding connections shall be tested and certified in accordance with IEEE837, UL487A and UL 467.

d. Manufacturer

1) ABB Furseweld Installation Products

2) Burndy Thermoweld

3) Erico Cadweld

4) Or equal

5)

G. Ground Bus - Welded

1. Bus Bar

a. All bars shown include insulators, stainless steel brackets, stainless steel mounting bolts and are UL Listed

b. All EGB, TGB and TMGB bars shall meet ASTM B187-C11000 Standard for copper, and ANSI/TIA/EIA-J-STD-60 1/4" thick copper, length as indicated on Drawings. Minimum height 2 inches.

c. Electro-tin plating

2. Bus Bar Brackets

a. Type 304 stainless steel

b. 1/8" thick

3. Insulators (Stand Off)

a. Manufactured from a halogen-free, fiberglass-reinforced thermoset unsaturated polyester molded compound (BMC)

b. Meet the requirements of UL® 94 V-0 for self-extinguishing materials.

4. Fasteners:

a. 3/8" Type 304 stainless steel.

1) Indoor rating: 600 volts.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide a separate, insulated equipment grounding conductor with each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.

B. Run all exposed grounding electrode conductors and equipment grounding conductors in conduit.

C. Use a minimum of #8 AWG copper wire to ground all piping, tanks, handrails and other conductive equipment or structures including ductwork and floor gratings.

D. Use grounding bushings on all conduits stubbed up below equipment, panelboards, switchboards and motor control centers. Bond all conduits to ground bus. Use

grounding bushings to ground electrical equipment and exposed non-current carrying metal parts.

E. Use the following types of ground connections for the grounding electrode system:

1. Cable to cable & cable to ground rod: Use exothermic weld type

2. Cable to building structural and reinforcing steel: Use exothermic weld type

3. Cable to piping: Use mechanical type

F. Supplementary Grounding Electrode: Use effectively grounded metal frame and rebar of the building and ground rods spaced a minimum of 10 feet apart in sufficient quantity to have a measured resistance to ground of not more than 5 ohms.

G. Use minimum #6 AWG copper conductor for communications service grounding conductor. Leave 10' slack conductor at terminal board.

H. Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only to service grounding electrode.

I. Drive ground rods one foot below finished grade.

J. Ground the water pipe as required by NEC Article 250. Provide a grounding jumper over the water meter as required. Provide a grounding jumper over all meters installed on incoming metallic piping for utility equipment.

3.2 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation and compliance with NEC Article 250.

3.3 TESTING

A. Perform ground tests using a low resistance, Null balance type, ground testing ohmmeter, with test lead resistance compensated for. Use the type of test instrument which compensates for potential and current rod resistances.

B. Test the grounding electrode system using a fall of potential three-point test and measure ground resistance. This test shall be performed by a third-party NETA–certified testing company. Submit tabulation of results to the Engineer. Include identification of electrodes, date of reading and ground resistance value in the test reports. If the resistance is not 5 ohms or less, contact the Engineer. The Engineer will initiate design changes, if necessary, to obtain acceptable values of ground resistance.

C. Ground resistance of conduits, equipment cases, and supporting frames, shall not vary from that of system as a whole and shall not exceed 0.5 ohms to ground. Measure resistance to ground of representative items, as directed by the Engineer. Submit all readings to the Engineer.

END OF SECTION

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SECTION 260529

ELECTRICAL HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Support channel
2. Cable Tray
3. Fastening hardware
4. Anchor bolts
5. Polymer Housekeeping Pads

1.2 REFERENCES

A. ASTM A-780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dipped Galvanized Coatings

1.3 SUBMITTALS

A. Submit shop drawings, product data, and reports.

1.4 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 PRODUCTS

2.1 SUPPORT CHANNEL

A. Support channel shall be hot dipped galvanized steel unless noted otherwise.

B. Support channel assembly hardware shall be galvanized steel.

C. Manufacturer:

1. Unistrut
2. B-Line
3. ABB Super Strut Installation Products
4. Or equal

2.2 GENERAL J-HOOK REQUIREMENTS

1. J-Hooks with Cable Retainers: Listed and labeled by a qualified testing agency and marked for intended location and application.
2. J-hooks with cable retainers shall comply with NFPA 70 and EN 50174-2 and meet ANSI/TIA-568-C and ANSI-TIA-569-C.

3. J-hooks shall be UL load and anti-corrosion tested.

4. J-hooks shall be RoHS compliant.

5. J-hooks shall be manufactured using over 70 percent recycled steel.

2.3 J-HOOK ACCESSORIES

1. Knock-On Steel Beam Clamp - 1/8" to 1/4": Catalog No. CJ24.

2. Knock-On Steel Beam Clamp - 5/16" to 1/2": Catalog No. CJ58.

3. Knock-On Spring Steel Beam Clamp - 1/8" to 1/2": Catalog No. CJFMP.

4. Pressed Beam Clamp: Catalog No. CJBC; fits on beam webs up to 1/2" thick.

5. Spring Steel Beam Clamp - 1/8" to 1/2": Catalog No. CJSSBC.

6. Z Purlin - 1/8" to 1/4": Catalog No. CJZ14.

7. C Purlin - 1/8" to 1/4": Catalog No. CJC14.

8. Bat Wing: Catalog No. CJBW; 12 gage - 1/4" ATR.

9. Wide Style J-Hook Extension Bracket: Catalog No. CJHEB; permits field creation of custom J-Hook Trees; top flange hole accommodates 1/4" hardware.

2.4 BRIDLE RINGS

A. Bridle Rings:

1. General: Bridle rings are cULus and RoHS compliant.

2. 1-1/4" Diameter Bridle Rings: Cablofil® Catalog No. CJ4T125; zinc-plated steel ring with [10-24] [1/4-20] threaded leg; suitable for smaller bundles of communication or data cabling.

3. 2" Diameter Bridle Rings: Cablofil® Catalog No. CJ4T2; zinc-plated steel ring with [10-24] 1/4-20] threaded leg; suitable for smaller bundles of communication or data cabling.

2.5 CABLE TRAY

A. Provide steel ladder style cable tray with hot-dipped galvanized finish 18 inches wide 4 inches deep with 9 inch rung spacing. Eaton B-Line Series or equivalent.

B. Install cable tray system in neat and workmanlike manner. Provide straight runs wherever possible.

C. Provide 30 degrees, 45 degrees and 60 degrees inside and outside cable tray sweeps where required to avoid physical obstructions, or change elevation.

D. Coordinate mounting heights with work of other trades. Provide lengths and quantities required for complete installation. Lengths and quantities of fittings shown on Drawings are diagrammatic only. Verify equipment quantities prior to ordering.

E. Where steel support channels are cut and unprotected steel is exposed, apply two coats of approved rust preventive paint to bare surfaces after proper cleaning. Color and type of rust preventive paint shall be as directed by Architect. In general, paint for galvanized metals shall be aluminum and others will be zinc chromate type, or as otherwise approved.

F. Miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws, and other such items, shall be galvanized or cadmium plated finish, or of other approved rust-inhibiting coatings.

G. Cable tray shall be supported from ceiling structures or walls where approved by Archi- tect.

H. Cable trays shall terminate on each side of fire rated partitions. Provide conduit sleeves at each partition and terminate conduits with bushed ends. After cables are installed, conduits shall be fire-stopped.

I. Ground all cable trays with bare copper #6 AWG to local panel ground bus telecommunications ground bus and building steel.

2.6 FASTENING HARDWARE

A. All fastening hardware shall be galvanized steel unless noted otherwise.

2.7 ANCHOR BOLTS

A. Anchor bolts shall be suitable for cracked or uncracked concrete and CMU construction.

B. Anchor bolts, nuts, washers, bolt sleeves, and assembly hardware shall be Type 316 stainless steel.

C. Use expansion anchors in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces.

D. Manufacturer:

1. Hilti, Kwik-Bolt TZ SS 316
2. Powers Fasteners, Power-Stud+ SD6
3. Simpson Strong-Tie, Strong-Bolt 2
4. Or Equal

2.8 PIPE CLAMPS AND STANDOFFS

A. Pipe clamps and standoffs shall be rigid one hole, galvanized malleable iron type. They shall be of the same manufacturer and shall be designed to be used together.

B. Strut pipe clamps shall be 2-piece type, galvanized steel.

C. The finish shall be suitable for the piping system being supported.

2.9 THREADED RODS

A. Threaded hanging rods shall be galvanized and be one piece. The size shall be suitable for the loads being supported.

2.10 SCREWS

A. Use Sheet Metal Screws in sheet metal studs.

B. Use Wood Screws in wood construction.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, preset inserts or beam clamps. Do not use spring steel clips and clamps.

B. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

C. Do not use powder-actuated anchors.

D. Hanger rods shall be subjected to tension only. Lateral and axial movements shall be accommodated by proper linkage in the rod assembly.

E. Fabricate supports from support channel rigidly welded or bolted to present a neat appearance. Galvanized structural steel may be used where galvanized support channel is allowed. Use galvanized steel hexagon head bolts with spring lock washers under all nuts. Coat ends of galvanized steel channel that has been cut with zinc-rich paint in accordance with ASTM A-780.

F. Install freestanding electrical equipment on 4 inch concrete housekeeping pads.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide channel supports to stand cabinet 1 inch off wall.

H. Bridge studs top and bottom with galvanized steel channels to support flush-mounted cabinets and panelboards in stud walls.

I. Use standoffs for all surface mounted conduit to maintain ¼ inch space between conduits and walls.

END OF SECTION

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SECTION 260533.13

CONDUIT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Intermediate metallic conduit (IMC)
2. Electrical metallic tubing (EMT)
3. Liquidtight flexible conduit
4. Fittings and conduit bodies
5. Conduit wall seals, new walls
6. Conduit wall seals, existing walls
7. Fire stop fittings
8. Conduit expansion joint
9. Cold galvanizing compound

B. Related Sections

1. Section 260526, Grounding and Bonding
2. Section 260529, Electrical Hangers and Supports

1.2 REFERENCES

A. ACI 318 – Building Code Requirements for Structural Concrete

B. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies

C. ANSI/NFPA 70 - National Electric Code

D. UL-6 – Standard for Rigid Metal Conduit

E. ANSI C80.3 – Electrical Metallic Tubing, Zinc Coated

F. ANSI C80.6 – Intermediate Metal Conduit, Zinc Coated

1.3 SUBMITTALS

A. Shop drawings, product data and reports

B. Riser Diagrams for the electrical installation

1.4 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept conduit on site. Inspect for damage.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.6 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

D. Where it is necessary to core a hole through an existing concrete slab or wall, the Contractor shall conduct a survey with a pachometer or by similar means to identify the location of steel reinforcing bars. The new hole shall be located so as to avoid cutting reinforcing bars or existing embedded conduits. Where reinforcing steel is close enough together that it is not possible to core the required hole without cutting reinforcing bars, contact the Engineer for further direction before cutting a hole. Where reinforcing bars are cut without the consent of the Engineer, the slab or wall will be repaired at the expense of the Contractor.

PART 2 PRODUCTS

2.1 GENERAL CONDUIT REQUIREMENTS

A. Minimum Size:

1. All other locations: 3/4 inch minimum unless otherwise specified

B. Office Areas

1. Use EMT (electrical metallic tubing)

C. Conduit for Fire Alarm Systems:

1. In office areas, above lay-in tile ceilings, and hollow stud walls, EMT conduit shall be used.

2. In all other locations, Intermediate Metal Conduit shall be used.

3. All fire alarm conduit shall be factory painted red on the exterior.

D. All Other Locations:

1. Concealed: Use EMT (electrical metallic tubing)

2. Exposed: Use galvanized rigid steel conduit

E. Connections to portable equipment from junction boxes and connections to all motors: use liquid tight flexible conduit where metallic where metallic conduit is used.

1. Minimum Length: 12 inches

2. Maximum Length: 36 inches

2.2 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Description: Interlocked steel construction with PVC jacket

B. Liquidtight flexible metal conduit and fittings shall be appropriate outer jacket and metallic core for application requirements.

C. For use where metallic conduit is used.

D. Fittings: ANSI/NEMA FB 1.

1. Fittings shall be gasketed.

2. Dry Locations: zinc-coated or cast zinc

3. Wet or Damp Locations: cast zinc

4. Corrosive Locations: Stainless steel

E. Manufacturer

1. ABB Installation Products

2. Carlon

3. Anamet

4. Electriflex

5. Or equal

2.3 INTERMEDIATE METAL CONDUIT (IMC)

A. Description: ANSI C80.6; galvanized tubing

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel compression or set screw type

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel compression type or set screw type

2.5 CONDUIT WALL SEALS, NEW WALLS

A. Type - sleeve and compression ring on both ends

B. Provide compression rings with hex head screws on sealing assembly.

C. Manufacturers

1. O-Z Gedney, Type WSK

2. Equal by Crouse-Hinds

3. Or equal

2.6 CONDUIT WALL SEALS, EXISTING WALLS

A. Type - Suitable for core drilled holes

B. Manufacturer

1. O-Z Gedney, Type CSM
2. Equal by Crouse-Hinds
3. Or equal

2.7 FIRE STOP FITTINGS

A. Type - Fittings with elastomeric rings to seal smoke and fumes

B. Fire rating of seal to be equal to or greater than rating of wall

C. Manufacturers

1. O-Z Gedney, Type CFS
2. Or equal

2.8 FITTINGS AND CONDUIT BODIES

A. Fittings

1. Description – Fittings shall be threaded where intermediate metallic conduit is used, and compression type or set screw type where EMT is used. Material and coating to correspond with type of conduit system being used.

B. Conduit Bodies

1. Description – Conduit bodies shall be threaded and gasketed where rigid metallic conduit is used. Material and coating to correspond with type of conduit system being used:
    a. Steel, cast iron or copper-free aluminum with intermediate metal conduit
2. Manufacturer
    a. Appleton-Type Mogul
    b. Equal by ABB Installation Products
    c. Equal by O-Z Gedney
    d. Equal by Crouse-Hinds
    e. or equal

C. Conduit Hubs

1. Metallic hubs shall be threaded and sealing type with neoprene gasket.
2. Material:
    a. Zinc plated steel or cast zinc in dry locations
    b. Cast zinc or galvanized steel in damp or wet locations
3. Manufacturer
    a. Crouse Hinds – Myers hub Type HUB
    b. Equal by O-Z Gedney

c. Equal by RACO

d. Equal by Appleton

e. or equal

2.9 CONDUIT EXPANSION JOINT, RIGID METAL CONDUIT

A. Weather tight, internal ground, expansion joint for intermediate metal conduit, 4 inch maximum conduit movement

B. Manufacturer

1. ABB Type XJG Installation Products

2. Crouse-Hinds Type XJG

3. Appleton Type XJ

4. O-Z Gedney Type AX

5. or equal

2.10 COLD GALVANIZING COMPOUND

A. Cold galvanizing compound shall be applied to all field threads and shall be as manufactured by ZRC Products Company, a division of Norfolk Corp. or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Junction boxes shown on the Drawings shall be provided in locations indicated. Additional boxes shall be provided as needed to comply with NFPA 70 requirements.

B. Install conduit in accordance with NECA "Standards of Installation."

C. Arrange supports to prevent misalignment during wiring installation.

D. Support EMT using zinc coated steel straps, pipe hangers, U-bolt clamps and beam clamps.

E. Group related conduits; support using conduit rack. Construct rack using support channel; provide space on each for 25 percent additional conduits.

F. Fasten conduit supports to building structure and surfaces under provisions of Section 16070 260529.

G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

H. Do not attach conduit to ceiling support wires.

I. Arrange conduit to maintain headroom and present neat appearance.

J. Route exposed conduit parallel and perpendicular to walls.

K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

L. Maintain adequate clearance between conduit and piping.

M. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104°F.

N. Cut conduit square using saw or pipe cutter; de-burr cut ends.

O. Before installation of wires and cables, clean and dry inside of each conduit run.

P. Provide conduit bushings on the end of each conduit to prevent insulation damage. Bushing shall be grounding type where applicable.

Q. Connections to boxes/enclosures:

1. Use conduit hubs with sealing gaskets on all boxes and enclosures, except those with NEMA 1 rating.

2. Use two locknuts, one inside and one outside of each box and enclosure when enclosure rating is NEMA 1.

R. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.

S. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints per Manufacturer's best practice and recommendations.

T. Provide 100-lb. test nylon pull string in each conduit 2 inch or larger except sleeves and nipples.

U. Use suitable caps (cast metal or thermoplastic) to protect installed conduit against entrance of dirt and moisture.

V. Ground and bond conduit in accordance with Section 260526.

W. Do not penetrate waterproofing membranes in the structural floor slab or foundation walls without approval by, and in a manner acceptable to the Engineer.

X. Install rigid metal conduit using only threaded fittings.

Y. Install a chromium plated, spun or split type escutcheon on all exposed conduits passing through walls or ceilings.

Z. Extend pipe sleeves 3/4 inch above finished floors.

AA. Install a water and fire resistant caulking around all conduits passing through floors.

BB. Install motor feed and control wiring in the same conduit only when shown on the Drawings or as approved by the Engineer.

CC. Install all empty conduits in floor so finished installation is flush with finished floor. Use suitable coupling and pipe plug.

DD. Provide thru wall seals on all conduits passing through foundation walls.

EE. For penetrations in existing walls, patch with mortar and touch up paint. Match existing paint color.

FF. For penetrations in fire rated walls, use materials that maintain the fire rating of the wall.

GG. For penetrations in new concrete walls, provide conduit nipple cast into the concrete.

HH. Provide conduit expansion joints for underground conduits that enter a building through an exterior wall or connect to an exterior mounted disconnect switch, meter, or other equipment.

END OF SECTION

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SECTION 260533.16

BOXES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Wall and ceiling outlet/device boxes

2. Pull and junction boxes

3. Covers

1.2 REFERENCES

A. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies

B. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports

C. NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)

D. UL514 A – Metallic Outlet Boxes

1.3 SUBMITTALS

A. Shop drawings, product data, and reports

1.4 PROJECT CONDITIONS

A. Verify that the field measurements are as shown on the Drawings.

B. Verify locations of outlets in offices and work areas prior to rough-in.

C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. Include installation within 5 feet of location shown.

1.5 DESIGN REQUIREMENTS

A. Unless otherwise specified or indicated on Drawings, NEMA rating for boxes shall correspond as follows to location classifications indicated on Drawings. Indoor locations for which a classification is not indicated are to be considered dry locations unless otherwise designated by Code. Outdoor locations are to be considered wet locations unless otherwise indicated.

1. Dry locations - NEMA 1 Metallic Boxes

PART 2 PRODUCTS

2.1 WALL AND CEILING OUTLET/DEVICE BOXES

A. Sheet Metal (stamped steel) Outlet/Device Boxes

1. NEMA OS 1, galvanized steel.

2. Provide green grounding screw.

3. Stamped steel boxes shall be used only above accessible ceilings and within Gypsum wall board walls.

4. Acceptable Manufacturers

   a. ABB Steel City Installation Products

   b. Appleton

   c. Raco

   d. or equal

B. Cast Metal Outlet/Device Boxes

1. NEMA FB 1, Type FD, cast iron or copper-free aluminum with internal green grounding screw terminal.

2. Shall be suitable for use in wet locations when used with gasketed covers.

3. Cover shall be by box manufacturer, and shall have stainless steel cover screws and a neoprene gasket.

4. Boxes shall have external mounting feet cast into the box assembly, screw-in feet will not be acceptable.

5. Material and coating shall match that of the conduit system being used.

6. Provide threaded sealing conduit hubs on all conduit entries.

7. Acceptable Manufacturers

   a. ABB Installation Products

   b. Crouse-Hinds

   c. Appleton

   d. Hubbell

   e. or equal

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Pull and Junction Boxes

1. NEMA OS 1, Galvanized or Painted Steel.

2. Provide green grounding screw.

3. Boxes shall not contain knockouts, unless used with EMT or IMC conduit.

4. Acceptable Manufacturers

   a. ABB Steel City Installation Products

   b. Raco

   c. Appleton

d. or equal

2.3 COVERS

A. Provide covers for all boxes. Cover material and coating shall match the box, unless otherwise specified. Covers shall be screw fastened or hinged and comply with NEMA Standards OS 1, OS 2 or FB 1.

PART 3 EXECUTION

3.1 INSTALLATION

A. All junction boxes and pull boxes associated with the fire alarm system shall be field painted red with a red cover.

B. Install electrical boxes as shown on Drawings. Provide additional boxes as required to comply with NFPA 70 requirements, for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Install motor feed and control wiring in the same box only when shown as combined in a single raceway on the Drawings or as approved by the Engineer.

D. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

E. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

F. Use flush mounting outlet boxes in finished areas.

G. Secure flush mounting box to interior wall without damaging wall insulation or reducing its effectiveness. Accurately position to allow for surface finish thickness.

H. Do not fasten boxes to ceiling support wires.

I. Fasten boxes to walls, ceilings or strut supports; do not support boxes from equipment, panels, etc.

J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

K. Use gang box where more than one device is mounted together. Do not use sectional box.

L. Provide permanent barriers in common boxes to limit voltage between adjacent switches to 300 volts or less.

M. Common boxes used for gang installation with switches, receptacles, and low voltage devices shall include barriers between the devices and the switches or receptacles.

N. Through-the-wall outlet boxes shall not be permitted. Outlet boxes shall not be installed back-to-back but shall be staggered on opposite sides of partitions a minimum of 12" on center.

O. The Contractor shall furnish and install outlet boxes for all wiring devices as shown on the drawings.

P. Bar hanger type outlet boxes shall be used in hollow frame partitions, other than masonry or construction block partitions, with bar hanger supported from (2) partition studs for wood stud partitions. For metal stud partitions, bar hanger shall be secured with self-threading metal screws or drill through hangers with caddy clips.

Q. Sheet Metal Outlet/Device Boxes

1. Use only above accessible ceilings and within Gypsum wall board walls.

R. Pull and Junction Boxes

1. Use sealing conduit hubs on all conduit entries.

3.2 ADJUSTING

A. Install knockout closure in unused box opening.

END OF SECTION

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SECTION 260553

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Nameplates

2. Wire and cable markers

3. Pressure sensitive labels for wiring devices

1.2 REFERENCES

A. NFPA 70 National Electrical Code.

B. NFPA 70E Standards for Electrical Safety in the Workplace

C. NFPA 99 - Health Care Facilities Code

D. Facilities Guidelines Institute -2018

E. NEMA WC5 - Thermoplastics - Insulated Wire and Cable for Transmission and Distribution of Electrical Energy

F. ANSI C57

1.3 SUBMITTALS

A. Provide schedule for nameplates.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Engraved two-layer plastic, white letters on a black background

B. Nameplate Wording:

1. Wording of the nameplates shall be in conformance with Drawings and acceptable to the Owner.

2. Wording of the nameplates for each piece of equipment shall be based on the common name and tag number (when applicable) of the equipment.

2.2 DEVICE LABELS

A. Labels shall be pressure-sensitive nylon stick-on labels equal to Brady, Seton or 3M.

B. Labels shall be white with black lettering for concealed locations and clear with black lettering for exposed locations indicating panel and circuit number.

2.3 WIRE AND CABLE MARKERS

A. Wires up to AWG10: Split sleeve or tubing type waterproof markers (Thomas & Betts, Panduit, Burndy or equal).

B. Wires AWG8 and larger: Plastic impregnated cloth markers, resistant to abrasion, moisture, dirt and oil (Ideal, Panduit, Brady or equal).

2.4 LIGHTING AND POWER JUNCTION BOX IDENTIFICATION

A. Permanently identify lighting and power junction box covers with circuit and panel board number on the outside with permanent marking pen.

2.5 PANELBOARD DIRECTORIES

A. Each panel directory shall be typewritten, indicate specific and clear area of control, using architectural room numbers, and protected by a plastic covering.

B. Each panel directory shall include the conductor color code.

C. Each panel directory shall indicate the voltage and phase of the feeder, ID of the feeder, and location of the feeder disconnect.

D. Each switchboard, panel board, and motor control shall be marked to warn of the potential electric arc flash hazards to comply with NFPA 70E and ANSI Z535.41998

PART 3 EXECUTION

3.1 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Secure nameplates to equipment fronts using ASA Type U drive screws, and water-resistant adhesive. Secure nameplate to face of panelboard doors one third of the way down from the top of the door. Embossed tape will not be permitted for any application.

3.2 DEVICE LABEL INSTALLATION

A. The following items shall be equipped with nylon stick-on labels: Provide labels for:

1. Receptacles

2. Line Voltage Lighting switches

3. Motor toggle switches

4. Special receptacles

3.3 PULL AND JUNCTION BOX IDENTIFICATION

A. Each pull and junction box shall be neatly identified with permanent black marker or stick on labels on the outside of the box (where the box is concealed) and on the inside of the box (in exposed locations).

B. Identify each pull and junction box with a system description as follows:

1. Lighting – Ltg, Panel, Ckt 2.

2. Receptacles – Rec, Panel, Ckt 3.

3. Equipment – AHU-1 or MZU-1, Panel, Ckt 4.

4. Fire Alarm – FA, Panel, Ckt

3.4 WIRE IDENTIFICATION

A. Provide wire markers on each end of each conductor in panelboard gutters, pull boxes, outlet and junction boxes, switchgear, switchboards, motor control centers, control panels, at each load connection and at each terminal board connection. Identify wiring as following:

1. Power and lighting circuit wires: Wire markers shall identify (a) power source/panelboard name and circuit ID number (e.g. "LP-1,2,3"), and (b) load/equipment name (e.g. "VFD 1").

2. Control & signal wiring: The identification on wire markers shall match the ID tag number of the wire/terminal shown on the associated equipment shop drawings.

B. Circuits passing through junction boxes shall be individually grouped and bound with Ty-raps.

C. Include the following color coding of all conductors used for power or lighting circuits.

1. 120/240 volt, single phase 3 wire

a. Black - Phase A

b. Red - Phase B

c. White - Neutral

d. Green - Equipment ground

2. 120/208 volt, three phase 4 wire

a. Black - Phase A

b. Red - Phase B

c. Blue - Phase C

d. White - Neutral

e. Green - Equipment ground

D. Color coding of multiconductor control cables shall be in accordance with NEMA Standard WC5.

3.5 NAMEPLATE ENGRAVING SCHEDULE

A. Provide nameplates of minimum letter height as scheduled below.

B. Panelboards - ¼ inch to identify equipment designation, 1/8 inch to identify voltage rating and source.

C. Switches in Panelboards - ¼ inch to identify circuit and load served, including location.

D. Motor Starters and VFDs - ¼ inch to identify circuit and load served, including location.

E. Individual Circuit Breakers, Enclosed Switches, Remote Operator Stations, Time Clocks, Control Devices, and Motor Starters – 1/8 inch to identify load served.

F. Pumps, fans, and other electrical equipment - ¼ inch to identify circuit and equipment designation.

G. Equipment with More Than One Power Source, Including Motors with Heaters - ¼ inch to identify power sources. Mount nameplate on motor disconnect switch, equipment enclosure, or other prominent location.

H. Provide a red nameplate/marker stating “Fire Alarm” tag at the circuit breaker feeding fire alarm system equipment, ELOCK-FA circuit lockout kit by Space Age Electronics or equal.

END OF SECTION

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SECTION 260800

ELECTRICAL TESTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Testing of Electrical Systems - General
2. Electrical Test Equipment
3. Electrical Test Procedures
4. Specific Electrical Tests

B. Related Sections

1. Section 26 05 26 – Grounding and Bonding
2. Section 26 05 53 – Electrical Identification

1.2 REFERENCES

A. Connecticut Electrical Code

B. NFPA 99 - Health Care Facilities Code

C. Facilities Guidelines Institute -2018

1.3 SUBMITTALS

A. General: Testing shall be performed, with satisfactory results, prior to connecting and energizing equipment. Problems discovered as a result of testing shall be corrected and retesting performed prior to connecting and energizing equipment.

B. The following test reports shall be submitted

1. Motor test results
2. Megger test results
3. Wire and cable continuity test results
4. Grounding system test results
5. System functional test reports

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 TESTING OF ELECTRICAL SYSTEMS - GENERAL

A. Provide supervision, labor, materials, tools, test instruments and other equipment or services and expenses required to test, adjust, set, calibrate, and operationally check work and components of the various electrical and control systems and circuitry throughout the contract.

B. Pay for all tests specified in Division 26, including expenses incident to re-tests occasioned by defects and failures of equipment to meet specifications. Unless otherwise specified, the Owner will supply the electric current necessary for tests.

C. After completion of testing replace wiring and equipment found defective (defined as failing to meet specified requirements).

D. Do not void equipment warranties or guarantees by testing and checkout work. Checks and tests shall be supplemental to and compatible with the manufacturer's installation instructions. Where deviations are apparent, obtain the manufacturer's approved review of procedure prior to testing. Where any repairs, modifications, adjustments, tests or checks are to be made, contact the Engineer to determine if the work should be performed by or with the manufacturer's representative. All checks and tests specified for proper operating and safety of equipment and personnel are to be performed concurrent with progression of the work, prior to final acceptance by the Owner.

E. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, or faulty, is to be reported to the Engineer. Corrective action requires Engineer’s approval prior to re-testing, and inspection.

F. Prior to testing and start-up, equipment and wiring shall be properly and permanently identified with nameplates, and other identification as specified in Section 26 05 53. Check and tighten terminals and connection points, remove shipping blocks and thoroughly clean equipment, repair damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions for delivery to the Engineer. Make routine checks and tests as the job progresses to ensure that wiring and equipment is properly installed.

G. Testing and checkout work is to be performed with fully qualified personnel skilled in the particular tests being conducted. Personnel are to have at least 5 years of experience with tests of same type and size as specified.

H. Conduct tests in presence of the Engineer. Notification is required 7 calendar days or more in advance when any test is to be performed, and do not start tests without approval.

I. Make openings in circuits for test instruments and place and connect instruments, equipment, and devices, required for the tests. Upon completion of tests, remove instruments and instrument connections and restore circuits to permanent conditions.

J. Identify test being performed, conductor or equipment the test is being performed on, date the test was performed, value of test results, person performing the test, the witness to the test, and the serial and model number and description of test instrument. Arrange information in tabular form and submit to the Engineer for approval.

K. When the electrical tests and inspections specified or required within Division 26 are complete and results reported, reviewed, and approved, that portion of the electrical equipment system or installation may be considered electrically complete. Affix appropriate, approved, and dated completion or calibration labels to the tested equipment and notify the Engineer of electrical completion. If the Engineer finds completed work unacceptable, he will notify the Contractor in writing of unfinished or deficient work, with the reason for his rejection, to be corrected by the Contractor. The Contractor will notify the Engineer in writing when exceptions have been corrected. The Contractor will prepare a "notification of Substantial Electrical Completion" for approval by the Engineer following the Engineer's acceptance of electrical completion. If later in-service operation or further testing identifies problems attributable to the Contractor, these will be corrected.

3.2 ELECTRICAL TEST EQUIPMENT

A. Test equipment used is to be inspected and calibrated.

B. Perform calibration and setting checks with calibrated test instruments of at least twice that of the accuracy of the equipment, device, relay or meter under test. Dated calibration labels shall be visible on test equipment. Calibrations over 6 months old are not acceptable on field test instruments. Inspect test instruments for proper operation prior to proceeding with the tests.

C. Perform ground tests using a low resistance, Null balance type, ground testing ohmmeter, with test lead resistance compensated for. Use the type of test instrument which compensates for potential and current rod resistances.

3.3 TEST PROCEDURES

A. Prepare procedures and schedules for the work specified herein. This work is to be coordinated and compatible with both the work and schedule of the other crafts. Sequence the tests and checks so that the equipment can be energized immediately after the completion of the application tests.

B. The test procedures shall provide specific instructions for the checking and testing of each electrical component of each system. Schedule tests and inspections as the job progresses.

C. Testing and checkout work shall be conducted in a safe manner. Provide the following special safety precautions, as appropriate:

1. Locking and tagging procedures
2. Barricades
3. Deenergization and/or isolation of equipment prior to testing
4. Review of procedures with the Engineer and Resident Project Representative
5. Erection of warning signs
6. Stationing of guards and watchmen
7. Maintenance of voice communications
8. Personnel orientation

D. Before energizing any machine, visually inspect for serviceability. Check manufacturer's instruction manual for correct lubrication and ventilation. Align motor with driven equipment. Check nameplate for electrical power requirements.

E. Insulation resistance measurements for motor feeders shall be performed with motors disconnected, measure insulation resistance from load side of contactors or circuit breakers.

F. Perform insulation tests at the following times and conditions:

1. Prior to energization and/or placing into service.

2. When damage to the insulation is suspected or known to exist.

3. After repairs or modifications to the equipment affecting the insulation.

4. Where lightning or other surge conditions are known to have existed on the circuit.

G. Where ground test results identify the need for additional grounding conductors or rods that are not indicated or specified, design changes will be initiated to obtain the acceptable values.

3.4 SPECIFIC ELECTRICAL TESTS

A. Motors

1. Perform insulation tests on motor windings and record results.

2. Test run motors 1 HP and above uncoupled or unloaded, before placing into operation. Check the motor for rotation, speed, current and temperature rise under normal load and record the results.

B. Wire and Cable

1. Continuity test each control and/or low voltage (below 480 volts) wire and cable to verify the field applied tag per conductor and record results.

C. Perform insulation tests on electrical equipment, apparatus, generators, transformers, power circuit breakers and switches, and similar electrical equipment.

D. Relay Panels, Operator and Instrument Control Panels, Programmable Controllers, Micro-Processors, Battery Systems and Other Miscellaneous Equipment

1. Upon completion of equipment installation, visually and functionally test equipment and their control devices for tightness of connections and for proper operation. In the case of battery systems, static inverters and similar equipment, follow manufacturer's recommended test and installation manuals upon review and approval by the Engineer. In the case of operator, instrument, and relay panels and cabinets or devices used solely for control, functionally test each circuit for proper operation and compliance with the Drawings and Specifications. Where functional testing is deemed undesirable by the Engineer from a safety or plant operational standpoint, then continuity and terminal connection verification checks will be acceptable.

E. Grounding Systems

1. Test in accordance with Section 26 05 26.

END OF SECTION

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SECTION 262416

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Panelboards

2. Molded case circuit breakers

B. Related Sections

1. Section 260553 – Electrical Identification

2. Section 262816– Circuit Breakers

1.2 REFERENCES

A. NEMA PB 1 - Panelboards.

B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

1.3 SUBMITTALS

A. Provide outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

PART 2 PRODUCTS

2.1 MANUFACTURERS - PANELBOARDS

A. Panelboards, 208/120 volt with mains from 100 amperes to 400 amperes, max 42-84 branch circuits and no branch breakers over 100 amperes, shall be:

1. Eaton, PRL-1

2. Square D, NQ

3. Siemens, P1

4. ABB/General Electric, AQ

5. or equal

B. Panelboards, 208/120 volt with mains from 100 amperes to 400 amperes, max 60 branch circuits with MCB, or max 74 branch circuits with MLO, and no branch breakers over 225 amperes, shall be:

1. Eaton, PRL-3

2. Square D, NF or I-Line

3. Siemens, P3

4. ABB/General Electric, AD

5. or equal

2.2 PANELBOARDS

A. Panelboards: NEMA PB-1; circuit breaker type

B. Enclosure: NEMA Type 1 in dry locations, NEMA Type 4 in wet or damp locations, unless otherwise indicated on Drawings

C. Provide cabinet front with hinged cover, and hinged door with flush lock. Finish in manufacturer's standard gray enamel.

D. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards. Provide separate insulated neutral bus, where required.

E. Provide factory installed lockable hasps for all breakers.

F. Provide surge protection device (SPD) as specified in Section 264900 or where shown on drawings.

G. Ratings

1. All panels and individually mounted circuit breakers shall have short circuit ratings as specified in Section 260500.

2. All panelboards shall be UL listed and labeled. Panels shall have ratings not less than the short circuit ratings available from the power sources.

3. Panelboards shall be labeled with a UL short circuit rating. Panelboards shall be fully rated.

H. Trims

1. Trims for all panelboards shall be supplied with a door-in-hinged-door. Interior door shall cover all circuit breaker handles and not uncover any live parts. Outer hinged door shall have a piano/continuous hinge and shall open to provide access to all wire gutter space on both sides of circuit breakers. Doors shall have a semi-flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners. Refer to drawings for surface or recessed mounted. Switching device handles shall be accessible.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Provide circuit breakers in accordance with Section 262816.

B. Provide bolt-in circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

C. Provide factory installed lockable hasps for all breakers.

D. Field-Adjustable Trip Circuit Breaker: NEMA AB 1; provide circuit breakers rated 100 amperes and larger with mechanism for adjusting long time, short time continuous current, short time, long time pickup current, and instantaneous setting for automatic operation.

E. Trip-free mechanism independent of manual handle control.

F. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

G. Provide ground fault interrupter circuit breakers for circuits indicated on Drawings.

H. Do not use single pole breakers with handle tie for multipole use.

PART 3 EXECUTION

3.1 INSTALLATION

A. Panel board shall be wall mounted, as shown on the Drawings.

B. Install wall mounted panelboards plumb in conformance with NEMA PB 1.1, at a height of 6 feet to the top of the panelboard.

C. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

D. Make all electrical connections including grounding.

E. Provide engraved nameplates in accordance with Section 260553.

F. Provide a red marking "Fire Alarm Circuit" on the fire alarm control panel circuit breaker. Provide a red lock for this circuit breaker indicating "Fire Alarm", ELOCK-FA circuit lockout kit by Space Age Electronics or equal. Provide a permanent sign for the fire alarm control panel stating the location of this circuit breaker.

G. Provide a blue marking "Premises Security Circuit" on the security control panel circuit breaker. Provide a permanent sign for the security control panel stating the location of this circuit breaker.

3.2 FIELD QUALITY CONTROL

A. With all equipment connected and functioning normally, measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20%, rearrange circuits in the panelboard to balance the phase loads within 20%. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection - Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

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SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Wall switches
2. Occupancy Sensors
3. Receptacles
4. Cover plates
5. Miscellaneous

B. Related Sections

1. Section 260533.16 - Boxes

1.2 SUBMITTALS

A. Product Data: Provide catalog sheets for wiring devices.

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Single Pole Switch - 20 Amp, 120/277 VOLT

a. Specification grade, standard toggle, handle color shall be as selected by the Architect Hubbell - Model 1221

b. Equal by Pass & Seymour

c. Equal by Bryant

d. or equal

B. Double Pole Switch - 20 Amp, 120/277 volt, handle color shall be as selected by the Architect

1. Specification grade, standard toggle

a. Hubbell - Model 1222

b. Equal by Pass & Seymour

c. Equal by Bryant

d. or equal

C. Three-way Switch - 20 Amp, 120/277 volt, handle color shall be as selected by the Architect

1. Specification grade, standard toggle

a. Hubbell - Model 1223

b. Equal by Pass & Seymour

c. Equal by Bryant

d. or equal

D. Four-way Switch - 20 Amp 277 volt, handle color shall be as selected by the Architect

1. Specification grade, standard toggle

a. Hubbell - Model 1224

b. Equal by Pass & Seymour

c. Equal by Bryant

d. or equal

2.2 LIGHTING CONTROLS

A. 0-10V Dimming Wall Switch

1. Dimming switch has five white LEDs that indicate the current dim level

a. Locator LED can also be programmed to be be white and/or more intense

b. Locator LED can also be disabled

2. High-End & Low-End Trim

a. High-end trim enables energy saving task tuning by setting a maximum level (100%-50%) that which users are allowed to raise lights

b. Low-end trim enables minimum user level of dimmer to be raised

3. Turn On/Turn Off Dimming Operation

a. Sensor turns on lighting to last user level or can be programmed to a preset level (100%, 50%, or custom)

b. Sensor can turn off lighting by switching off power (by opening relay) or dimming below electronic off level

c. Lighting can also be held at low-end trim level during unoccupied/off state

4. Fade On/Fade Off Times

a. Adjustable time for level to ramp up to turn-on level (0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec)

b. Adjustable time interval for level to ramp down to off (0.75 sec, 1.5 sec, 3 sec, 5 sec, or 15 sec)

5. Dimming Curve

a. The dimming curve defines how the dimmer unit adjust its voltage output in response to button commands

b. Linear (default), Square LogPreset feature allows user to return to previous light level when turning lights ON

c. Integrated full-slide control for easy, precise operation

6. Catalog numbers shall be as follows:

a. Intelligent Lighting Controls ILC-SWX-803-WH-J10-LIC-SWX-199

b. Equal by Watt Stopper

c. Equal by Pass & Seymour

d. Or equal

B. Low Voltage Wall Switch

1. Momentary switch operation with a pulse length of 250 msec.

a. Multiway Switching Capable (e.g., 3-way, 4-way)

1. Catalog numbers shall be as follows:

a. Intelligent Lighting Controls ILC-SWX-801-WH-J10-ILC-SWX-199

b. Equal by Watt Stopper

c. Equal by Pass & Seymour

d. Or equal

C. Wall Switch Occupancy Sensor

1. Passive Infrared Single Level Occupancy Sensing Wall Switch is an all-in-one motion sensing lighting control and conventional wall switch.

2. Air-gap switch ensures no leakage current to load

3. Selectable built-in light level sensor

4. NEMA WD7 Guide robotic method utilized to verify coverage patterns

5. LED Rated

6. Catalog numbers shall be as follows:

a. Intelligent Lighting Controls ILC-SWX-121-WH-J10-ILC-SWX-199

b. Equal by Watt Stopper

c. Equal by Pass & Seymour

d. Or equal

D. Dual Technology Ceiling Mounted Occupancy Sensor – To be used in area with visibility to daylight. Provide sensor types with daylighting features in locations with exterior windows.

1. Occupancy sensors shall be ultrasonic and passive infrared technology.

2. Sensor shall have 180° field of view and shall cover up to 500 ft^2 (for minor motion),1000 ft2 and 2000 ft2.

3. Sensor shall be self-adjustable, 15 seconds/test (10 minutes Auto), or Selectable 5, 15, 30 minutes, or Zero Time Delay.

4. The sensor shall have adjustable light level setting of 10–300 fc. The contractor shall set sensor for manual ON, the light level setting to 60 fc and the adjustable time delay shall be set to auto mode.

5. Sensor shall have BAS with Isolated Form C Relay (-R) model and Isolated Form C Relay Ratings: 1A 30 VDC/VAC

6. Catalog numbers shall be as follows:

    a. Intelligent Lighting Controls

        1) Standard: ILC-SWX-2211

        2) With Auxiliary Relays: ILC-SWX-2211-AR

        3) With Daylight Dimming Feature: ILC-SWX-2211-D

    b. Equal by Watt Stopper

    c. Equal by Pass & Seymour

    d. Or equal

A. Daylight Harvesting Ceiling Mounted Sensor

1. Auto-Setpoint Selection Mode

2. Adjustable High & Low Dimming Trim Level

3. Works Together w/ Low Voltage Occupancy Sensors

4. Compact Size and Matte Finish

5. Mounting Nipple Attachment with Integrated Hole Saw

6. Catalog numbers shall be as follows:

    a. Intelligent Lighting Controls PS-IND

    b. Equal by Watt Stopper

    c. Equal by Pass & Seymour

    d. Or equal

B. Switching Power Packs

1. Operating Voltage 120/277 VAC

2. Class 2 output ratings

    a. 18 VDC, 150 mA

    b. Connected device power: 80 mA

3. Load Ratings
    a. 20A @ 120 V -General Purpose Plug Load
    b. 20A @ 120/277 VAC -General Purpose, Tungsten, Magnetic Ballast
    c. 16A @ 120/277 VAC -Electronic Ballast, LED Driver
4. DC Load Ratings:
    a. 20A @ 28 VDC (MAX)
    b. 1A @ 5 VDC (MIN)
5. Dimming Load
    a. (Models with -D2 option only)
    b. 50mA, (0-10 VDC ballasts or drivers compliant with IEC 60929 Annex E.2)
6. Motor Load:
    a. 1 HP
7. Catalog numbers shall be as follows:
    a. Intelligent Lighting Controls
        1) Standard: ILC-SWX-900-AX
        2) Dimming Feature: ILC-SWX-900-AX-D2
    b. Equal by Watt Stopper
    c. Equal by Pass & Seymour
    d. Or equal

C. Dimming Power Packs
1. Operating Voltage 120/277 VAC
2. Class 2 output ratings
    a. 24 VDC, 350 mA
    b. 24VDC, 350mA out on CATNetwork
    c. Switched: Latching, NEMA 410 rated
        1) 20A, 277V (resistive loads)
    d. 30mA, 0-10VDC Dimming Sink Current
    e. SCCR rating: 5kA
    f. Isolated Form C Relay: 1A, 30V AC/DC Load Ratings
3. Catalog numbers shall be as follows:
    a. Intelligent Lighting Controls ILC-SWX-900-AX-D2

b. Equal by Watt Stopper

c. Equal by Pass & Seymour

d. Or equal

D. Receptacle Rated Switch Pack

1. Operating Voltage

a. 120, 277 VAC

2. Load Ratings

a. General Use: 20A

b. Resistive: 20A

c. Tungsten: 20A

d. Standard Ballast: 20A

e. Electronic Ballast: 16A

f. Motor:

1) 1.5HP @ 120 VAC

2) 2.0HP @ 277 VAC

3. Catalog numbers shall be as follows:

a. Intelligent Lighting Controls ILC-SWX-900-AX

b. Equal by Hubbell

c. Equal by Pass & Seymour

d. Or equal

E. Room Controller:

1. Input Requirements:

a. 120-277 VAC 50/60Hz

b. Maximum 20A combined load per Room Controller Ballast load: 20A @ 120/277 VAC

c. (LED) Incandescent load: 15A @ 120 VAC

d. Motor load: 1HP @ 120 VAC

e. LED Drivers: Requires isolated LED drivers for optimal performance

f. LED, Ballast or Incandescent Load: 3A

2. Class 2 Dimming Output:

a. 0-10 VDC, sinks up to 100mA per (40 μA max per circuit leakage to line)

b. Each 0-10V output supports up to 50 ballasts / drivers that draw the standard 2mA each

3. Standards/Ratings

a. UL Approved

b. UL 508 Listed

c. UL 924 Listed

d. cULus Listed

4. Warranty

a. Five year warranty standard

5. Catalog numbers shall be as follows:

a. Intelligent Lighting Controls LLEVO-TC, LLEVO-INT-2

b. Equal by Hubbell

c. Equal by Pass & Seymour

d. Or equal

A. Relays:

1. Input Requirements:

a. 120-277 VAC 50/60Hz

b. Maximum 20A combined load per Room Controller Ballast load: 20A @ 120/277 VAC

c. (LED) Incandescent load: 15A @ 120 VAC

d. Motor load: 1HP @ 120 VAC

e. LED Drivers: Requires isolated LED drivers for optimal performance

f. LED, Ballast or Incandescent Load: 3A

2. Class 2 Dimming Output:

a. 0-10 VDC, sinks up to 100mA per (40 μA max per circuit leakage to line)

b. Each 0-10V output supports up to 50 ballasts / drivers that draw the standard 2mA each

3. Standards/Ratings

a. UL Approved

b. UL 508 Listed

c. UL 924 Listed

d. cULus Listed

4. Warranty

    a. Five year warranty standard

5. Catalog numbers shall be as follows:

    a. Intelligent Lighting Controls R20D

    b. Equal by Hubbell

    c. Equal by Pass & Seymour

    Or equal

2.3 RECEPTACLES

A. Duplex 20A, 125 V, 1 phase, 3 wire, grounding

1. Heavy duty, hospital grade, nylon, straight blade, tamper resistant, decorator, color as selected by the Architect

    a. Hubbell - Model 2182WLTRA

    b. Equal by Pass & Seymour

    c. Equal by Bryant

    d. or equal

    e. or equal

B. Duplex 20A, 125 V, 1 phase, 3 wire, grounding Ground-fault Circuit Interrupter Receptacle

1. Heavy duty, hospital grade, nylon, straight blade, tamper resistant,decorator, color as selected by the Architect

    a. Hubbell - Model GFTWRST83WU

    b. Equal by Pass & Seymour

    c. Equal by Bryant

    d. or equal

2.

2.4 COVER PLATES

A. Decorative Cover Plate - Smooth nylon, color as selected by the Architect

1. Hubbell - Catalog Number

    a. One gang duplex receptacle - P8

    b. One gang GFCI duplex receptacle - HPSI I

    c. One gang toggle switch - P1

    d. Two gang toggle switch - P2

e. Three gang toggle switch - P3

f. Four gang toggle switch - P4

g. Blank, one gang - P14

h. One gang, telephone outlet - P12

i. Switch, duplex receptacle - P18

2.5 MISCELLANEOUS

A. Motor Rated Switch/Motor Control - 20 A, 120 V A.C., specification grade, Ivory, 1-1/2 horsepower

a. Hubbell - Model GFTWRST83WU

b. Equal by Pass & Seymour

c. Equal by Bryant

d. or equal

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and will be completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on bottom.

E. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

F. Connect wiring devices by wrapping conductor around screw terminal.

G. Install smooth cover plates on switches and receptacles where MC cable and EMT conduit is used.

H. Use jumbo size plates for outlets installed in masonry walls.

I. Install galvanized steel plates on metallic outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets. Label with panelboard identity and circuit number.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 260533.16 to obtain mounting heights specified and indicated on Drawings.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 18 inches above finished floor unless otherwise noted on plans.

D. Coordinate with Architect's elevations for exact mounting heights and device orientations.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch .

C. Confirm occupancy sensors operate lighting upon activation.

D. Verify that each receptacle device is energized.

E. Test each receptacle device for proper polarity.

F. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

END OF SECTION

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SECTION 262816

CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Circuit Breakers

1.2 REFERENCES

A. NEMA AB 1 – Molded Case Circuit Breakers.

B. NEMA KS 1 – Enclosed Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

C. UL98 – Enclosed and Dead Front Switches

1.3 SUBMITTALS FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Dimensioned outline drawing

2. Conduit entry/exit locations for enclosed breakers

3. Ratings including:

a. Short-circuit rating

b. Voltage

c. Continuous current

4. Cable terminal sizes

5. Product data sheets

B. Shop drawings, product data, and reports.

C. Circuit breaker trip current and let-through current curves, outline dimensions, and terminal lug sizes.

1.4 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

1.5 REGULATORY REQUIREMENTS

A. Use circuit breakers listed by ' a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA, and suitable for specific application.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Square D

C. ABB

D. Approved Equal

2.2 MOLDED CASE CIRCUIT BREAKERS THROUGH 2500AMPS

A. Protective devices shall be UL489 Listed molded case circuit breakers with inverse time and instantaneous tripping characteristics.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated in specification section 260500.

D. Provide accessories including shunt trips, bell alarms and auxiliary switches as shown on the contract drawings.

E. All circuit breakers shall be UL Listed fully rated (use of a series rating of breakers will not be considered)

F. Where indicated provide UL listed circuit breakers for applications at 100% of their continuous ampere rating in their intended enclosure.

G. Enclosure: For enclosed circuit breakers, NEMA 1 indoor dry locations, and NEMA 3R raintight (lockable) for outdoor locations,

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as shown on Drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

A. Install circuit breakers and switch assemblies where shown on Drawings, in accordance with manufacturer's instructions.

B. Provide all necessary hardware and supports and make all wiring connections.

3.3 FIELD QUALITY CONTROL

A. Inspect visually and perform several mechanical ON-OFF operations on each circuit breaker and switch assembly.

B. Verify circuit continuity on each pole in closed position.

END OF SECTION

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SECTION 262817

DISCONNECT SWITCHES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Switch Assemblies

B. Related Sections

1. Section 260529 – Electrical Hangers and Supports

1.2 REFERENCES

A. UL 98

B. NEMA KS 1 – Enclosed Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

1.3 SUBMITTALS

A. Dimensioned outline drawing

B. Conduit entry/exit locations

C. Switch ratings including:

D. Short-circuit rating

E. Voltage

F. Continuous current

G. Fuse ratings and type

H. Cable terminal sizes

I. Product data sheets

1.4 REGULATORY REQUIREMENTS

A. Use switch assemblies listed by a nationally recognized testing laboratory, and suitable for specific application.

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an

acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 REGULATORY REQUIREMENTS

A. The safety switches shall bear a nationally recognized testing laboratory label.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Square D

C. Siemens

D. Or equal

2.2 HEAVY-DUTY SWICHES – GENERAL REQUIREMENTS

A. Interrupting Rating: See specification section 260500 for minimum requirements.

B. Switch ampacity shall meet or exceed the circuit ampacity shown on the drawings.

C. Construction

1. Switch blades and jaws shall be visible and plated copper.

2. Switches shall have a red or black handle that is easily pad-lockable with 3/8-inch shank locks in the ON and OFF position.

3. Switches shall have defeatable door interlocks that prevent the door from opening when the handle is in the ON position (except for double-throw switches). Defeater mechanism shall be front accessible.

4. Mechanical lugs suitable for aluminum or copper conductors.

5. Switches shall have deionizing arc chutes.

6. Switch assembly and operating handle shall be an integral part of the enclosure base.

7. Switches rated 30 A to 600 A shall have reinforced fuse clips.

8. Switch blades shall be readily visible in the "ON" and "OFF" position.

9. Switch operating mechanism shall be non-teasable, positive quick-make/quick-break type. Bail type mechanisms are not acceptable.

10. Fusible switches shall be suitable for service entrance equipment

11. Switches shall have line terminal shields (except for non-fusible double throw switches)

12. Switches shall be suitable for systems capable of 200 kA at 480 V with Class J, L, R, or T fusing as applicable for single-throw switches; 100 kA at 600 V for double-throw switches.

13. Designed to accommodate Class R fuses unless otherwise indicated.

14. Embossed or engraved ON-OFF indication shall be provided

15. Double-make, double-break switch blade feature shall be provided

16. Fuse pullers shall be provided on all NEMA 4X and 12 switches through 200 A

17. Renewal parts data shall be shown on the inside of the door

D. Enclosures

1. NEMA 1 for indoor dry locations.

2. NEMA 3R for outdoor locations.

3. Paint color shall be ANSI 61 gray. NEMA 7 & 9 shall have epoxy power coat finish internal and external.

E. Provide the following option and accessories:

1. Phenolic nameplates

2. Factory installed neutral assemblies

3. Fuse clips factory installed

4. Control pole factory installed

5. Factory installed fuse pullers

6. Factory installed copper lugs

7. Factory installed ground lug kits

8. Factory installed auxiliary contacts in all disconnect switches downstream from VFDs or Soft-Starters.

9. Factory installed listed switching neutral bonding kit for 3 or 4 pole double throw switches requiring a switching neutral

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as shown on Drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

A. Install switch assemblies where shown on Drawings, in accordance with manufacturer's instructions.

B. Provide all necessary hardware and supports and make all wiring connections.

C. Support equipment of this Section in accordance with Section 260529.

D. Provide fuses in all fusible switch assemblies, whether fuses are shown on the drawings or not. Unless shown otherwise or required by an equipment manufacturer, provide fuses rated for the full ampacity of the disconnect switch frame. For HVAC equipment, coordinate manufacturer-required fuse size with HVAC contractor.

3.3 FIELD QUALITY CONTROL

A. Inspect visually and perform several mechanical ON-OFF operations on each switch assembly.

B. Verify circuit continuity on each pole in closed position.

END OF SECTION

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SECTION 262913.03

ENCLOSED MOTOR STARTERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Fractional horsepower motor starters
2. Enclosed motor starters
3. Motor starters mounted in control panels

B. Related Sections

1. Section 264900 – Components and Accessories

1.2 REFERENCES

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. NEMA AB 1 - Molded Case Circuit Breakers.

C. NEMA ICS 1 - Standards for Industrial Control and Systems.

D. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

E. ICS 3 - Industrial Systems.

F. ICS 4 - Terminal Blocks.

G. NEMA KS 1 - Enclosed Switches.

1.3 SUBMITTALS

A. Product data on motor starters.

B. Manufacturer's instructions.

C. Project specific wiring diagrams.

1.4 OPERATION AND MAINTENANCE DATA

A. Provide spare parts listing, source and current prices of spare parts and supplies, and recommended maintenance procedures and intervals.

1.5 SPARE PARTS

A. Furnish the following spare parts. Each part shall be marked on its exterior packaging with typewritten labels identifying the specific part, part number, and manufacturer.

1. One complete set of fuses for each kind of enclosed motor starter.
2. Two indicating lamps of each type.
3. One type overload of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Square D

C. Siemens

D. Allen-Bradley

E. Or equal

2.2 FRACTIONAL HORSEPOWER MOTOR STARTERS

A. Description: NEMA ICS2, general purpose, Class A with toggle switch operation and overload protection.

B. Enclosure: NEMA Type 12 for indoor dry locations; NEMA Type 4 for wet or damp locations. Enclosure shall be flush mount type for office and lab areas. For Class I Division 1 or 2, wet and corrosive locations, enclosures shall be rated NEMA 7 and NEMA 4.

2.3 ENCLOSED MOTOR STARTERS

A. Description: NEMA ICS2, AC general purpose Class A magnetic motor starter for induction motors rated in horsepower, full voltage starting, non-reversing or reversing type, single speed or two-speed, as indicated on the Drawings (or as required).

B. Motor starter assemblies shall have a short circuit current rating (SCCR) of at least that specified in 16050.

C. Operating Voltage: voltage and phase as indicated on the Drawings.

D. Coil Operating Voltage: 120 volts, 60 Hertz (or as required)

E. Size: NEMA ICS2, size as shown on the Drawings or as required by the motor horsepower rating.

F. Overload Relay: The overload relay assembly shall be of the electronic type with the following features:

1. Ambient insensitive

2. Class 10, 20 or 30 protection (selectable)

3. Fixed phase loss protection (selectable on/off)

4. Adjustable phase unbalance protection

G. Combination Motor Starters: Combine motor starter with motor circuit protector in common enclosure.

H. Enclosure: NEMA Type 1 for dry indoor locations, NEMA Type 3R for outdoor locations, other type as indicated on the Drawings.

I. Control Power Transformer (if required): 120 volts secondary (24 volts if required for HVAC related starters), 75VA minimum or higher if required by the loads.

J. Auxiliary Contacts – NEMA ICS 2: minimum of two normally open and one normally closed field convertible contacts in addition to seal-in contact. Provide additional contacts as required by the Drawings and one spare normally open contact.

K. Motor Circuit Protection – NEMA AB 1; FS W-C 375; adjustable circuit breakers with integral instantaneous magnetic trip in each pole.

L. Devices Included: Pushbuttons, selector switches, relays, auxiliary contacts, elapsed time meters, pilot lights, terminal boards, connecting lugs and other devices as required and as shown on the Drawings. Devices shall be as specified in Section 264900. Provide internal wiring.

M. Pushbuttons, Indicating Lights, Selector Switches: NEMA ICS2; industrial, heavy duty, oil tight type. The "compact control components" are unacceptable. Provide transformer type pilot lights with lenses and color coded as indicated by the Plans.

2.4 MOTOR STARTERS MOUNTED IN CONTROL PANELS

A. Description: NEMA ICS2, AC general purpose Class A magnetic motor starter for induction motors rated in horsepower, full voltage starting, non-reversing or reversing type, single speed or two-speed, as indicated on the Drawings (or as required).

B. Motor starter assemblies shall have a short circuit current rating (SCCR) of at least that specified in 16050.

C. Operating Voltage: voltage and phase as indicated on the Drawings.

D. Coil Operating Voltage: 120 volts, 60 Hertz (or as required)

E. Size: NEMA ICS2, size as shown on the Drawings or as required by the motor horsepower rating.

F. Overload Relay: The overload relay assembly shall be of the electronic type with the following features:

1. Ambient insensitive

2. Class 10, 20 or 30 protection (selectable)

3. Fixed phase loss protection (selectable on/off)

G. Adjustable phase unbalance protection

H. Combination Motor Starters: Combine motor starter with motor circuit protector.

I. Auxiliary Contacts: Provide auxiliary contacts as shown on the Drawings (or as required).

J. Control Power Transformer (if required): 120 volts secondary, 24 volts if required by system supplier, 75VA minimum or higher if required by the loads.

K. Devices Included: Provide devices as shown on the Drawings. Devices shall be as specified in Section 260913 and Section 264900.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install motor control equipment in accordance with manufacturer's instructions and as shown on the Drawings.

B. Select and install overload relay in motor starters to match installed motor nameplate current and service factor.

C. Motor Data - Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage/phase rating, MCP trip setting, overload heater size and motor starter size.

D. Provide all conduit, wiring and grounding interconnections.

E. Make all required continuity and operational tests.

F. Set motor circuit protectors at lowest setting that permits operation of the motor without tripping the motor circuit protector.

END OF SECTION

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SECTION 264820

Fire Alarm System – Non-Voice

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Fire Alarm Monitoring and Control Panels
2. Manual stations
3. Smoke detectors
4. Heat detectors
5. Carbon monoxide detectors
6. Duct detectors
7. Horns/strobe units
8. Visual indicating devices
9. Remote annunciator
10. Knox box
11. Rotating beacon
12. Master Box
13. System suitable for type occupancy as defined by local and State Building Code and as approved by Fire Chief.

B. Related Sections

1. Section 26 05 00} - Basic Electrical Requirements
2. Section 26 05 53 - Electrical Identification
3. Section 26 05 19 - Conductors and Cable
4. Section 26 05 33} – Conduit
5. Section 26 05 33.16} – Boxes

1.2 REFERENCES

A. The General Documents, as listed on the Table of Contents and applicable parts of Division 1, General Requirements, and applicable requirements of project specification binder, shall be included in and made part of this Section

B. Examine all drawings and criteria sheets and all other Sections of the specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other Trades affecting or affected by work of this Section. Cooperate with such Trades to assure the steady progress of all work under the Contract.

D. Provide all material, labor and equipment, to complete the work of this Section in strict accordance with the design Architect's and Engineer's plans and specifications, and with all applicable codes, rules, and standards.

1.3 COORDINATION

A. The work of this Section shall be coordinated with other work of the Contract. The placement of all raceways shall be coordinated with other trades prior to installation.

1.4 CODES AND STANDARDS

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of, the Contract Documents:

1. Connecticut State Electric Code - NFPA 70

a. Comply with applicable requirements of NEC standards pertaining to fire alarm systems

2. ASME A17.1: Safety Code for Elevators

3. Comply with local and state building codes

4. NFPA: National Fire Protection Association

a. 72: Nation Fire Alarm Code

b. 90A: Installation of Air conditioning and Ventilating Systems

c. 101: Life Safety Code

d. ADA: American Disability Act

5. IBC: International Building Code

6. UL Compliance and Labeling - Comply with provisions of UL safety standards pertaining to fire alarm systems; and provide UL labeled products and components

1.5 GUARANTEE

A. In addition to the specific guarantee requirements of the General Conditions, the Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities which the Contractor may have by law or other provisions of the Contract Documents.

B. Furnish the Owner a written two year warranty (material and labor) from the approved certificate of completion, signed by manufacturer/vendor against defects in materials and workmanship.

C. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of four (4) inspections and tests per year for 5 years in compliance with NFPA-72 guidelines.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions of the Contractor.

B. The Contractor shall provide adequate locked storage space with shelving for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt. The Contractor shall store fire alarm equipment in clean, dry place; protect the equipment from weather, dirt, fumes, water construction debris, and physical damage; and handle fire alarm equipment carefully to prevent damage, breaking, and scoring. Do not install damaged equipment or components; replace with new.

C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received and shall send copies of these receipts to the Architect.

1.7 QUALITY ASSURANCE

A. Each and all items of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the UL label. Partial listing shall NOT be acceptable.

B. All control equipment must have transient protection devices to comply with UL 864 requirements.

1. All external surge protectors shall comply with UL #497B requirements.

C. The Contractor quoting the Fire Alarm System Installation shall be the Owner's single point of contact for all issues that may arise during the project associated with the fire alarm system. The contractor shall be responsible for all coordination of materials, labor, installation, startup, testing, and warranty.

D. Manufacturer's Qualifications - Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products have been in satisfactory use in similar service for not less than 10 years.

E. Contractor Qualifications - Firms with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project.

1. Firm with manufacturer's factory trained personnel.

2. Firm with factory authorized service organization and spare parts stock.

1.8 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall thoroughly instruct the representative of the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The Contractor shall make arrangements, via the Architect, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the period of time in which they are to be given. The Architect shall be completely satisfied that the representative of the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Contractor to the Owner's representative, then the Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been fulfilled.

B. The Contractor shall submit to the Architect for approval, the required typed sets (see Division 1; General and Supplementary General Requirements), bound neatly in loose-leaf binders, of all instructions for the installation, operation, care and maintenance of all equipment and systems (including instructions for the ordering and stocking of spare parts for all equipment installed under this Contract). The lists shall include part numbers and suggested supplier. Each set shall also include an itemized list of component parts that should be kept on hand and where such parts can be purchased.

C. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner for review prior to final submission of manuals.

D. The instructions shall contain information deemed necessary by the Architect and include but not limited to the following:

1. Introduction
    a. Explanation of Manual and its use.
    b. Summary description of the Electrical systems.
    c. Purpose of systems.
2. System
    a. Detailed description of all systems.
    b. Illustrations, block diagrams, catalog cuts, and other exhibits.
3. Operations
    a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting. Include all posted instruction charts.
4. Maintenance
    a. Parts list and part numbers.
    b. Maintenance, and replacement charts and Contractor's recommendations for preventive maintenance.
    c. Troubleshooting charts for systems and components.
    d. Instructions for testing each type of part.
    e. Recommended list of on-hand spare parts.
    f. General or miscellaneous maintenance notes.
5. Manufacturer's Literature
    a. Complete listing for all parts with names, addresses and telephone numbers.
    b. Care and operation.

c. All and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.

d. Internal wiring diagrams and engineering data sheets for all items and/or equipment to be furnished.

e. Guarantee and warranty data.

1.9 MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the on-site services of a competent factory trained Project Manager, Construction Manager, and field technicians. Manufacturer's project manager and construction manager shall be identified in the bid package.

B. Provide resume for each individual with bid package. The Owner reserves the right to reject the project manager and construction manager without cause.

C. Manufacturers' construction managers shall attend weekly job meetings.

1.10 SHOP DRAWINGS & SUBMITTALS

A. The following minimum shop drawings shall be submitted as part of the fire alarm system:

1. Detailed component and equipment list with model numbers.

2. Manufacturer's specification sheets for each item of equipment.

3. Description of how specified system functions.

4. Confirmation that manufacturer's representative will provide job site supervision during system installation, perform final testing and instruct operating personnel on system operation.

5. Standby battery calculations showing system power requirements and formulas used to compute the 24 hours of standby power, and 5 minutes full alarm condition.

6. Detailed one-line schematic wiring diagrams of specified system and interconnection wiring.

7. Device specific wiring and termination diagrams.

8. Cable Schedule and types, including outside diameter of cables for sizing conduits.

9. Building riser diagram.

10. List of all node addresses (to be submitted as part of operations manual).

11. Points programmed.

B. Shop drawings submitted for approval without this information will not be considered for approval.

C. In addition to the shop drawing, the contractor shall be responsible for reading and understanding manufacturer's product inserts to ensure proper installation and operation of the device.

1.11 FIRE ALARM MONITORING AND CONTROL SYSTEM

A. General

1. Furnish and install an extension of the existing intelligent reporting, microprocessor controlled, addressable, fire detection and emergency alarm communication system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, auxiliary control devices, power supplies, and wiring as shown on the drawings and specified herein.

2. The fire alarm shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

3. The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel (FACP) indicating that the device and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.

4. The equipment and completed installation shall meet the approval of the City of New Haven Fire Department, the Connecticut State Fire Marshall, Authorities having jurisdiction, and in accordance with applicable sections of the latest edition of NFPA 72 National Fire Alarm and Signaling Codes.

5. Each and all items of the fire alarm system shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the UL label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.

6. All control equipment must have transient protection to comply with UL 864 requirements. Where fire alarm circuits leave the building, additional transient protection must be provided for each circuit. Devices must be UL listed under Standard 497B (Isolated Loop Circuit Protectors).

7. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications and all circuits must be marked in accordance with NEC Article 760.

8. The system shall permit maximum system expansion and Owner flexibility with a minimum of additional field wiring. The system shall be wired, connected, tested and left in first class operating condition.

9. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history.

10. Provide the services of a factory certified fire alarm representative/technician for all technical support required for a complete and operational system.

11. Installation and testing of water flow and tamper switches provided under Division 21. Flow and tamper switches shall be provided under the Division 21. Coordinate exact location of flow and tamper switches with Division 21.

12. The work under this Contract shall also include all labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items essential for proper installation and operation, even though not specifically mentioned or indicated on the drawings, but which are usually

provided or are essential for proper installation and operation of all systems as indicated on the drawings and specified herein.

13. The specifications and drawings describe the minimum requirements that must be met by the Contractor for the installation of all work as shown on the drawings and as specified hereinunder.

14. Provide all devices, remote interface units, components, wiring, programming and related work necessary for a complete "network/integrated" system.

B. System Requirements

1. The following equipment specifications are based on the extension of a Notifier AFP-200 fire alarm control panel to establish system configuration and performance.

2. The fire alarm monitoring and control system extension shall consist of all necessary hardware and software equipment to perform the following functions:

   a. Fire alarm and detection operations.

   b. Evacuation signaling system.

   c. Automatic control of elevator recall, egress door release under fire alarm conditions, remote monitoring of sprinkler, fire pump and emergency power systems.

   d. Remote control of door release.

   e. Interface with building HVAC control system.

3. Building HVAC Systems

   a. Duct smoke detectors for specific air handling units shall initiate alarm conditions and shall shut down the associated fan and a discrete signal shall be sent to the building automation system to indicate the fan has been shut down.

4. Elevator Recall

   a. Existing elevator recall fire alarm control panel shall remain and activate any and all nodes programmed for control of all required elevator recall operations. When alarms are reported, automatically, control relays at the designated nodes and connected to the elevator control circuitry shall energize and the elevators shall be recalled to the ground floor for firefighters' use. Should the fire be on the ground floor, the elevators shall be sent to the alternate safe floor, all per programming at the applicable nodes.

   b. The contractor shall be required to provide and control of the shunt trip breakers 120 volt shunt trip power. The breaker shall be provided and installed under this contract.

   c. Smoke detectors shall be installed in each elevator lobby, elevator shafts, and elevator equipment rooms, as indicated on the drawings. These detectors and these detectors only shall initiate the elevator recall Phase I Operation, in accord with FAC 4A-47 and ANSI/ASME A17.1. These detectors shall also initiate an alarm condition at the building fire protection

system and shall visibly indicate the alarm initiation circuit from which the alarm originated both at the control panel and any fire alarm remote annunciator(s).

d. The above referenced detectors shall initiate Phase I recall at all times, regardless of the status of the building fire protection system.

e. Where fire protection sprinkler systems are installed in elevator shafts, and/or mechanical rooms, heat detectors shall be installed in the elevator shaft and in elevator equipment rooms adjacent to the sprinkler head. Upon activation, detectors shall initiate a means of disconnecting the main electrical power to the elevator controller/driver as indicated on the drawings. Heat detectors shall have an operating temperature rating lower than the rating of operation for the installed sprinkler heads. System operation shall be such that power to the elevator disconnecting device is removed prior to the application of sprinkler water.

f. Warning lights located in elevator lobbies shall flash upon activation smoke detectors associated with the elevator protection system. Lights shall be manual reset only. Provide all associated relays, contacts, switches, wires, conduits, devices, etc. required for the described operation.

g. Provide a means of remote automatic disconnection of electrical power to the elevator controller/driver. Disconnecting means shall be a shunt trip breaker. Disconnecting means shall be activated upon a signal from the heat detectors located in the elevator shaft. Disconnecting means shall not be self resetting.

h. Only such electrical wiring, raceways and cables used directly in connection with the elevator may be installed in the elevator hoistway.

C. Fire Alarm System Operation

1. The activation of any manual fire alarm pull station, or the automatic actuation of any thermal detector, smoke detector, duct detector, sprinkler system water flow switch, or any other approved alarm initiating device shall immediately result in the following:

a. Report alarm to the Municipal Fire Station via approved means.

b. Notify the Owner's monitoring service.

c. Activate the evacuation signal throughout the building on all floors. The evacuation signal should be Temporal Code 3 in all areas and shall sound until signal silence is activated at the control panel.

d. All ADA visible alarm indicating appliances shall flash at a synchronized rate continuously until the system is reset.

e. Any subsequent alarm shall reactivate the alarm indicating appliances.

f. All doors normally held open by door control devices shall release. Electrically operated egress doors equipped with security access shall be overridden to allow passage.

g. The alarm shall be displayed on the fire alarm control panel LCD display and shall include a custom message. The system alarm LED shall flash on

the control panel until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another initiating device shall flash the system alarm LED on the control panel. The LCD display shall show the new alarm information.

h. Sound the alarm signal at the FACP and annunciators, and illuminate the system alarm LED. The alarm signal shall pulse until the appropriate "acknowledge" switch is depressed which shall cause it to be silenced. The system alarm LED shall remain illuminated until the alarm condition has been corrected.

i. All events shall be entered and stored in a software memory log.

j. Initiate elevator recall.

2. The activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the network fire alarm control panels. Differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring shall be provided.

a. Pressing the "Supervisory Acknowledge" key will silence the supervisory audible signal while maintaining the supervisory service LED "on" indicating the off/normal condition.

b. Restoring the valve to the normal position shall cause the supervisory LED to extinguish, indicating restoration to normal.

c. Restoring the valve to the normal position shall cause the supervisory audible signal to pulse indicating the restoration to normal position. The supervisory acknowledge key shall silence the audible signal.

PART 2 PRODUCTS

2.1 FIRE ALARM MONITORING AND CONTROL PANELS

A. Furnish and install microprocessor based, fire alarm monitoring notification appliance circuit panels to extend the existing fire alarm system to the locations throughout the Building. The system shall be modular to allow future additions without the need to replace the entire control. It shall display only those and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions.

1. Operation

a. The module will continuously "listen" for each of the addressable devices on its communications channel for status changes and/or trouble conditions.

b. Initiating circuits from the communicating device module shall be Class "B" (Style 4) supervised to provide an indication of sensing circuit faults. Supervision points shall not reduce available system alarm points. Control points shall be capable of initiating remote alarm signals or systems, and providing a momentary pulse to allow reset of remotely located fire or other types of local controls.

2. Equipment Enclosures

a. Provide cabinets of sufficient size to accommodate all equipment. Cabinet shall be equipped with locks and transparent door panel providing freedom from tampering yet allowing full view of the various lights and controls. Color of cabinets shall be per Fire Department Regulations..

B. Addressable Peripheral Network

1. Communication with addressable devices. The system must provide communication with initiating and control devices individually via addressable loop interface modules. All of these devices shall be individually annunciated at the control panel LCD. Annunciation shall include the following conditions for each point:

a. Alarm

b. Trouble

c. Open

d. Short

e. Device missing/failed

2. All addressable devices shall have the capability of being disabled or enabled individually.

3. Format

a. The communication format must be a completely digital "report by exception" protocol. 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. Systems utilizing a polling/response protocol will not be considered as equal.

4. Identification of Addressable Devices

a. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel or requires special programming tools are unacceptable. Any system that cannot accommodate the addition of an addressable device between existing devices and requires reprogramming all existing electrically further devices will not be acceptable. The system must verify that the proper type device is in place and matches the desired software configuration.

C. Wiring Type, Distances, Survivability and Configurations

1. Wiring types shall be approved by the equipment manufacturer. Class B (Style 4) communications shall be provided on all risers. Wire will be so routed to maintain sufficient distance between the feed and return loop as called for by the Authority having jurisdiction.

2. All cables shall be UL listed for fire protective signaling systems and meet the requirements of NEC 760.15 for non-power limited. All fire alarm cables shall be installed in conduit and cable types per manufacturer's recommendations.

3. Cable Types and minimum sizes. Contractor shall upsize wires as required to accommodate voltage drop.

   a. #18 TP for addressable loop signaling line circuits.

   b. #14 AWG for ADA visual light circuits, power circuits, door holders, security devices, etc.

   c. #16 TP data communication between network panels.

4. All wiring shall be installed in minimum 3/4" C or shall be Fire Alarm MC Cable. See Part 3 Execution for additional information.

5. "T" tapping of conductors shall be prohibited.

6. Auxiliary manual controls shall be supervised so that an "off/normal" position of any switch shall cause an "off/normal" system trouble.

7. Each independently supervised circuit shall display a message on the LCD readout to indicate disarrangement conditions per circuit. Systems with common trouble lamps or readouts for multiple indications will not be accepted.

8. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.

9. 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 control panel.

10. 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.

11. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

D. Power Requirements

1. Each notification appliance circuit (NAC)panel shall receive 120 volt AC power via dedicated circuits. The contractor shall provide power as required per the manufacturer's requirements. The contractor shall provide circuit breakers, conduits, and wire from the closest appropriate voltage panelboard. Provide breaker locks for all branch circuits. Obtain power from the closest 120 volt panelboard. Record on as-built drawings the branch circuits used for fire alarm system power.

2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 volt AC power in a normal supervisory mode and alarm condition for a period of 24 hours and 5 minutes of alarm. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. Power cable size from remote battery location to fire control center shall be determined from the battery backup calculations, and voltage drop.

3. All external circuits requiring system operating power shall be 24 volt DC power limited and shall be individually protected at the control panel.

4. Provide standby battery calculations showing system power requirements and formulas used to compute the 24 hours of standby power, and 5 minutes full alarm condition.

E. Addressable Devices

1. Addressable smoke detectors

a. The addressable smoke detectors shall be of the photoelectric type and shall make the alarm decision. Sensors that send an analog value to the panel to make the alarm decision shall not be considered equal.

b. The detectors shall be listed to UL, ULC and CSFM and shall be documented compatible with the control equipment to which they are connected. The detector shall be listed for both ceiling and wall mount applications.

c. Each detector shall contain an LED that lights when in alarm.

d. Each detector shall notify the control panel of its type identification to prevent inadvertent substitution of another sensor type. The control panel shall operate with the installed device but shall initiate a trouble condition until the proper type is installed or the programmed sensor type is changed.

e. The detector's electronics shall be immune from false alarms caused by EMI or RFI.

f. Cover all smoke detection devices with dust covers immediately after installation to maintain cleanliness. If detectors are contaminated with dirt or dust during the construction period, it shall be the responsibility of the Contractor, at his cost, to clean or replace each device as directed by the Owner's representative.

2. Addressable Thermal Detectors

a. Thermal detector heads must be UL listed. They will be a combination rate-of-use and fixed temperature 135°F type, automatically restorable.

b. In uninsulated and non-ventilated attic areas provide combination rate-of-use and fixed temperature 200°F type, automatic restorable

3. Addressable Pull Stations

a. Addressable pull stations will be UL listed and contain electronics that communicate the station's status (alarm, normal) to the control panel over (2) wires. The address will be set in the station. They will be manufactured from high impact red Lexan. Station will mechanically latch upon operation and remain so until manually reset. Pull stations shall be single action pull type.

b. The front of the station is to be hinged to a backplate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. Stations which use Allen wrenches or special tools to reset will not be accepted.

c. The addressable manual station shall be capable of field programming of its “address” location on an addressable initiating circuit. The manual station

shall be fitted with screw terminals for field wire attachment, the use of wire type pigtail connections will not be considered.

d. Pull station shall be mounted on the appropriate back box. The back box shall be capable of holding in addition to the pull station a monitor module, where required.

4. Addressable Modules

a. Addressable interface modules shall be used for monitoring and control of remote devices.

b. Addressable interface modules will be capable of mounting in a standard electric outlet box and will include cover plates to allow surface or flush mounting. They will communicate over the same circuits as the other addressable devices.

c. Individual addressable modules shall be used to provide addresses to sprinkler supervisory and water flow devices (mount within a 4" square outlet box).

d. Addressable modules shall be UL listed to operated in the temperature of the space they are installed. Refer to the architectural drawings for room temperatures.

5. Addressable Device Supervision

a. All modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions. Should the module become non-operational, tampered with, or removed, a discrete trouble signal, unique to the device, shall be transmitted to, and annunciated at, the control panel. The system control panel will be capable of displaying the type of trouble condition (open, short, device missing/failed).

b. Should a device fail it will not hinder the operation of other system devices.

c. There shall be no limit to the number of detectors, stations, or modules, which may be activated or "in alarm" simultaneously.

d. The use of circuits which are hardwired to the fire alarm control panel will not be considered as meeting the intent of these specifications and will not be considered.

F. Sprinkler System

1. All of the sprinkler flow switches, tamper switches, etc., are furnished by the Fire Protection System Supplier and all installation and wiring of the devices shall be done by Division 26.

a. Sprinkler alarm water flow detectors (that sound the building alarm signals).

b. Sprinkler OS&Y valve supervisory switches (that causes supervisory signals to sound when not in the normally open and ready condition).

c. A module shall be provided for each detector to individually annunciate the source of alarm.

G. Audio/Visual Alarm Signals Horns

1. Furnish and install combination horn-ADA visual alarm assemblies with red impact resistant and flame retardant thermoplastic injection molded frame and ADA compliant strobe lamp. Visual notification appliance output signal shall be 15, 30, 75, 95, 110, 115, 135, 150, 177, or 185 candela, and applied per room size guidelines in accordance with NFPA 72 guidelines. All visual strobes in the facility shall be 1 Hz synchronized flash and shall comply with ADA Standards.

2. Horn/Strobe shall provide field selectable low, medium or high dB output. The entire assembly shall be listed to UL 1971 and 464.

3. Horn/Strobe shall be 24 VDC.

4. In wet interior locations, exterior locations and in Freezers/Coolers surface mounted devices shall have manufacturer's wall/ceiling mounted weatherproof back box and shall have a NEMA 4X rating.

5. Provide System Sensor SpectraAlert Advance with selectable-output horns, strobes and horn/strobe assemblies, with an operating range of -40°F to 151°F.

6. Horns and Strobes shall be UL listed to operated in the temperature of the space they are installed. Refer to the architectural drawings for room temperatures.

H. Fire Alarm System Document Cabinet:

1. Provide fire department approved Fire Alarm System Document Cabinet. Space Age Electronics Catalog number SSU00689. Coordinate box requirements and location with fire department and project architect.

   a. 18 gauge cold rolled steel construction with red powder coat and white lettering

   b. Dimensions are 12" wide x 13" tall and 2 1/4" deep with stainless steel piano hinge with CAT30 door lock

   c. Two key ring hooks to hold system keys

   d. Business card holder for key contacts

   e. Slide tab allows user to select USB-C or Micro USB connector to download from 8GB digital flash memory

   f. Include DCD Computer Desk Kit to hold enclosure door open at a 90 degree angle with a snap on cable for a convenient working surface in the field. Includes velcro strap for securing your laptop.

I. Fire Alarm System Graphic Map:

1. Provide fire department approved Fire Alarm System Graphic Frame Space Age Electronics catalog number SSU00689. Coordinate graphics and layout requirements and location with fire department and project architect.

   a. Common uses for the CGF include evacuation maps, emergency instructions, code frames, location indication maps and building floor plans.

   b. Shatter-proof Lexan cover with 18 gauge steel construction

   c. Overall dimensions: 8 3/4" x 11 1/4" x 1/2" deep

J. Surge Suppression Devices (SSD)

1. The system shall utilize the following electrical surge protection devices to prevent damage and nuisance alarms caused by nearby lightning strikes, stray currents, or voltage transients.

2. Provide the appropriate SSD's listed below on the AC Input of all fire alarm panels, and remote power supplies:

   a. Transtector ACO100BWN3

   b. Leviton OEM-120EFI, EFI HWM-120

   c. Ditek DTK-120HW or DTK-120/240 CM.

3. AC Surge protectors shall be installed at the electrical panel board feeding the fire alarm equipment. Excess lead length shall be trimmed. The branch circuit conductor shall be formed into a 5-10 turn 1" diameter tie-wrapped coil just downstream of the suppressor connection.

4. On each DC fire alarm circuit entering or leaving the building: Transtector TSP8601, Citel American B280 -24V, Edco P264 and P642, Ditek DTKxLVL series, or equal.

5. DC Surge protectors shall be installed on each required circuit at the point of entry into the building.

6.

PART 3 EXECUTION

3.1 INSTALLATION

A. All devices shall be capable of operating in the ambient temperatures of the spaces in which they are being installed. Refer to the architectural drawings for room temperatures.

B. Provide and install the system in accordance with the plans and specifications, all applicable Codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC Article 760 Parts I and III, Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC Article 760 Parts I and II. Upon completion, the Contractor shall so certify in writing to the Owner and Engineer.

C. All junction boxes shall be red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation. Where the cable is run in conduit or EMT all pull boxes shall be painted red, and the conduit and/or EMT shall be factory painted RED. Provide products per Division 26 drawings and specifications.

D. The fire alarm system wiring shall be Fire Alarm MC cable in all joist space, above the walk on ceiling, above LAT or JWB ceilings and within stud construction. In all other areas the wiring shall be installed in conduit. The conduit shall be as required per Division 26 drawings and specifications.

E. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate Contractors.

F. The Contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.

G. The manufacturer's authorized representative shall provide on-site supervision of installation.

H. Refer to Part 3 of these specifications for additional requirements.

3.2 WARRANTY

A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of (2) years from the date of the completed and certified test and acceptance by the owner and his agents.

B. The contractor shall provide 4-hour response to emergency requests. For non-emergency service requests the contractor shall respond within 24 hours.

C. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of (4) inspections and tests per year in compliance with NFPA 72 Guidelines.

3.3 TRAINING

A. Provide two separate training sessions. One after the system is operational and turned over to the owner and a second 6 to 9 months later.

B. Each session shall be an 8-hour training program. Each program shall be presented by a fully qualified, trained representative of the equipment manufacturer who is thoroughly knowledgeable of the specific installation. It should be given to personnel responsible for operating the system and representatives of the Fire Department. The training sessions shall be for a maximum 20 owner employees per session.

C. The training program shall be a classroom type environment and shall include complete printed OEM manuals, OEM manual on CD, and any additional documentation as required for each participant.

3.4 QUALITY CONTROL

A. Prior to installation of any equipment, the Contractor shall provide the Engineer with copies of submittals for approval. Submittals shall include one-line riser diagrams of entire system and equipment specification sheets.

B. Make connections to panel under manufacturer's supervision. The manufacturer's representative shall be involved in the design to make sure that the system is fully functional.

C. The Contractor shall be responsible for assuring that conduit size and wire quantity, size and type are suitable for the equipment supplied. The Contractor shall review the proper installation of each type of device with the equipment supplier. Final connections between the wiring and equipment shall be made under the supervision of the equipment supplier's representative.

3.5 COORDINATION OF MONITORING

A. Provide a 5-year monitoring and reporting (to local fire department) contract with a guaranteed price to extend the contract an additional five years after the initial monitoring contract expires.

3.6 ACCEPTANCE TESTING

A. Upon completion, the Contractor shall conduct a functional test of the system for the Owner and Engineer.

B. To ensure that wire size, power supply, number of devices on a circuit, etc., are suitable to support 100% of devices being in alarm or operated simultaneously. Test shall include central control station and manual and automatic fire alarm systems. Test(s) shall include but shall not be limited to the following: Manual pull stations, evacuation signals/lights, thermal and/or smoke detectors, automatic door release devices, waterflow and supervisory alarm devices, elevator recall, fan shutdown, etc.

1. Place all detectors and monitor modules in alarm. Each shall display its address and alarm condition. At least the first (10) devices on each circuit shall also have their alarm LEDs lighted.

2. Operate all control modules for the alarm or operated condition. Each module shall display its address and condition.

3. Reset all alarmed and operated devices. The panel shall display the address of any off/normal devices.

4. Test each detector so programmed for alarm verification by momentarily testing for alarm. The detector shall not initiate an alarm. Then, test by placing the detector in alarm such that it remains in alarm for the selected verification time. The detector shall initiate an alarm.

5. Test each detector for trouble by removing the detector from its base. The address and trouble condition for each shall be displayed. Insert a different type of detector into the base. The address and trouble condition shall be displayed. The detector will return to normal only when the proper detector type is reinserted in the base.

6. Print out the English language descriptor and status of each module in the system. The printout shall also include the date and time.

7. Audible sound level measurements shall be conducted throughout the entire building and all spaces with the evacuation system sounding. These measurements shall be done to certify that all areas conform to the Fire Department sound level requirements for evacuation alarm signals. Measurements shall be recorded in the following format for each space:

"Room/Area"	"Ambient Sound Level" (dB)	"Ambient and Evacuation Sound Level" (dB)

8. All components, parts and assemblies supplied by the manufacturer shall be guaranteed against defects in materials and workmanship for a period of 24 months after final acceptance.

9. The permanent occupancy test shall be comprehensive to ensure that the system meets NFPA and local AHJ requirements. The system shall be turned over to the Owner, and warranty shall start from the date of final acceptance.

a. Test shall meet requirements of the following:

1) NFPA 72: Supervised Receiving Stations

2) NFPA 13A: Care and Maintenance of Sprinkler Systems

10. The equipment manufacturer shall have an office staffed with trained, full-time employees who are capable of performing testing, inspection, repair, and maintenance services for the life of the system.

11. Test shall comprise activating and verifying the operations of each and every device (input and output) and auxiliary functions. No exceptions to this requirement will be accepted. A written test log of this complete test shall be submitted prior to acceptance of the system by the Owner.

C. Provide four copies of verifications tests. Two shall be provided for temporary occupancy permits, one for the state elevator inspection and the other shall be for permanent occupancy. All tests shall comply with Paragraphs B and C below.

D. Before final approval and acceptance by Building Owner, fire protection and life safety systems shall be subjected to tests specified in any applicable NFPA Codes and Standards. Tests shall be witnessed by the representative of the Fire Department and by the representatives of the Owner's Building Construction Department, Risk Management Division and Security Department. At least 48 hours notice shall be given to aforementioned representatives before test.

3.7 DOCUMENT SUBMITTAL REQUIREMENTS

A. Tier Two, Shop Drawings.

1. Prior to installation of fire protection systems, shop drawings, where applicable, shall be submitted in accordance with section 107.1.2 and shall contain, but not be limited to; detailed design layout, equipment specifications, system sequence of operation, and analysis to substantiate the design. Shop drawings shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the fire protection systems.

2. EXCEPTION: For shop drawings of Fire Alarm and Detection Systems see section 907.1.2 for applicable requirements.

B. Tier Three, Record Drawings.

1. As built plans shall be provided to the owner for all fire protection and life safety systems that are sealed as reviewed and approved by the registered design professional or legally recognized professional performing construction control. Where changes to original shop drawings are minor, a list of as-built changes shall be permitted to be submitted where sealed and reviewed and approved by the registered design professional or legally recognized professional performing construction control in accordance with 780 CMR 1.00.

END OF SECTION

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SECTION 264900

COMPONENTS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Surge Protection Device (SPD)

2. Surface Floor Mounted Raceway with Service Fittings

1.2 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control Systems

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies

1.3 SUBMITTALS

A. Drawings to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, wire numbers, dimensions, support points, nameplate legends

B. Project Record Documents

1. Accurately record actual locations of control equipment. Revise diagrams included in Drawings to reflect actual control device connections.

C. Operation and Maintenance Data

1. Provide instructions for adjusting and resetting time delay relays, timers, and counters.

2. Provide recommended preventive maintenance procedures and materials.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience

1.5 SPARE PARTS

A. Furnish 2 complete control switches, pilot devices, and relays with contacts for each type utilized in this project.

B. Furnish 1 complete time delay relay and clock timer complete with contacts for each type utilized in this project.

PART 2 PRODUCTS

2.1 SURGE PROTECTION DEVICE (SPD) – ENCLOSED STAND ALONE

A. UL 1449, 5th Edition listed

B. Surge current/phase (8/20 μs): 1 Event: 200kA

C. Surge Life/Phase (8/20 μs): 10,000 Events: 10kA

D. Service Voltage: 120/208 volts, three-phase

E. Features:

1. LED status indicators for protection present and protection reduced.

2. Audible alarm with silence button

3. EMI/RFI filtering

4. Form C relay contact for fault/power loss signal

5. Surge counter with reset button

F. Modes of protection: Line-to-neutral, line-to-ground, line-to-line, neutral-to-ground.

G. Each phase shall be guarded by at least three redundant protection paths.

H. Lead length shall be as short and straight as possible, avoiding ninety-degree bends in the wire (LB fittings or similar will not be accepted). If the installed lead length must exceed five feet, the contractor shall use a low impedance cable that minimizes the lead length impact to the installed performance of the SPD.

I. Enclosure: NEMA 4, 14 gauge steel, powder coated.

J. 10 year warranty

K. Manufacturer:

1. MCG Surge Protection Model 200LS-208Y

2. Equal by Citel

3. Or Equal

L. Provide a 30 amp circuit breaker disconnect for the SPD.

2.1 SURFACE OVER FLOOR RACEWAY WITH SERVICE FITTINGS:

A. Overfloor Raceway Base & Cover OFRBC-8: Cover: 0.040" (1.0mm) steel. Base: 0.080" (2.0mm) aluminum. Durable black powder coat finish. Divided into four channels. UL 1449, 5th Edition listed.

B. Overfloor Raceway In-Wall Entrance End Fitting OFR10IW: Feeds OFR Series Overfloor Raceway from behind wall. Configurable to provide one or two channels of power. Has 1/2" trade size KO for single channel and 3/4" trade KO for two channels.

C. Overfloor Raceway Entrance End Fitting OFR10A: Feeds OFR Series Raceway. Has two (2) concentric 1/2" and 1 1/4" trade size KOs on end. Includes removable divider that can be positioned to feed any raceway channel. Can be used to feed raceway from wall or into furniture.

D. Overfloor Raceway 2-Gang Box OFR48-2: Divided two-gang device box. Allows multiple services (power, communication, A/V) at a single point-of-use. Side facing device mounting provides low profile, with space for large cable bend radius. Accepts OFR Series device plates. Removable divider can be aligned with any of the raceway channels.

E. Overfloor Raceway 4-Gang Box OFR48-4: Divided four-gang device box. Allows multiple services (power, communication, A/V) at a single pointof-use. Side facing device mounting provides low profile, with space for large cable bend radius. Accepts OFR Series device plates. Removable divider can be aligned with any of the raceway channels.

F. Provide all accessories for a complete overfloor raceway installation including overfloor raceway seam clips, grounding clips, couplers, wire clips, transition boxes, overfloor raceway blank end fittings and wiring device plates.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install devices and equipment in accordance with manufacturer's instructions.

B. Install individual relays and time delay relays in enclosures.

C. Make electrical wiring interconnections as shown on Drawings.

END OF SECTION

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SECTION 265100

LUMINAIRES

PART 1 GENERAL

1.1 SUMMARY

A. Examine all drawings and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

B. Coordinate work with that of all other Trades affecting or affected by work of this Section. Cooperate with such Trades to ensure the steady progress of all work under the Contract.

C. Provide all material, labor and equipment, to complete the work of this Section in strict accordance with the design engineer's plans and specifications, and with all applicable codes, rules, and standards.

D. The work under this Section shall include furnishing and installing interior and exterior lighting fixtures.

E. The work under this Contract shall also include all labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items essential for proper installation and operation, even though not specifically mentioned or indicated on the drawings, but which are usually provided or are essential for proper installation and operation of all systems as indicated on the drawings and specified herein.

F. The specifications and drawings describe the minimum requirements that must be met by the Contractor for the installation of all work as shown on the drawings and as specified hereinunder.

1.2 SUBMITTALS

A. Prepare and submit complete shop drawings of lighting fixtures required on this project to the Engineer for approval. Refer to specification section 01330 for additional information.

B. Submit samples of each material under this Section requested by the Engineer for approval. Samples shall be in size and form requested by the engineer, and reasonable to show characteristics, color and finishes of the materials.

C. Submit complete manufacturer's product data of all materials and systems to the engineer for approval, consisting of complete product description and specifications, complete performance test data, complete preparation and installation instructions, dimensions and all other pertinent technical data required for complete product and product use information.

D. All shop drawings shall have clearly marked the appropriate specification number of drawing designation for identification of the submittal.

E. Disposition of shop drawings shall not relieve the Contractor from the responsibility for deviations from drawings or specifications unless he has submitted, in writing, a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Contractor from responsibility for errors in shop drawings or schedules.

F. Shop drawings, samples, test data and certificates shall be submitted for approval in accordance with the requirements of the Contract Documents. Fixtures or other materials shall not be shipped, stored or installed into the work unless prior approval has been received, based upon the submittal of shop drawings, samples, catalogue cuts, test data, certificates or other materials submitted for approval. Make modifications to fixtures in accordance with Engineers comments concerning submittals, as a part of the work of this Section.

1. For each and every light fixture type the manufacturer shall submit the following information in the order listed below.

a. Light fixture cut sheet

b. Fixture accessories

c. Ballast/Driver cut sheet

d. Lamp cut sheet

1.3 REFERENCED STANDARDS

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of, the Contract Documents:

1. NFPA 70: National Electrical Code
2. UL: Underwriters' Laboratories
3. NEC: National Electrical Code
4. CBM: Certified Ballast Manufacturers Association
5. IES: Illuminating Engineering Society
6. ASTM: American Society for Testing and Materials
7. ANSI: American National Standards Institute

1.4 COORDINATION

A. Coordinate ceiling construction requirements with the General Contractor prior ordering of light fixtures.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions of the Contractor.

B. The Contractor shall provide adequate storage space for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.

C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received, and shall send copies of these receipts to the Engineer.

PART 2 MATERIALS

2.1 GENERAL

A. Provide materials, equipment, appurtenances and workmanship for the work of this Section conforming to the highest commercial Standards as specified and indicated on the drawings. Make fixture parts and components not specifically identified or indicated on the drawings, of materials most appropriate to their use or function, and resistant to corrosion and to thermal and mechanical stresses encountered in the normal application and function of the fixtures.

B. Provide fixtures that are constructed to be suitable for and compatible with the ceiling, wall or pavement materials and construction in which they shall be installed.

2.2 MARKING OF FIXTURES

A. Where applicable, mark fixtures according to proper lamp type. Provide markings that are clear and readily visible to service personnel, but invisible from normal viewing angles when lamps are in place.

2.3 MATERIALS AND FABRICATION

A. Provide fixtures, completely factory assembled, wired, and equipped with necessary sockets, wiring, shielding, reflectors, channels, lenses and other parts and appurtenances necessary to complete the fixture installation and deliver to project site ready for installation.

2.4 FINISHES

A. The engineer shall select finishes and indicate the color selections on the shop drawing submittals.

2.5 FIXTURE WIRING

A. Provide wiring channels and wireways free from projections and rough or sharp edges throughout. At points or edges over which conductors shall pass and may be subject to injury or wear, round bush to make a smooth contact surface with the conductors.

B. Install insulated bushings at points of entrance and exit of flexible wiring.

2.6 LED LIGHT FIXTURES, DRIVERS AND MODULES

A. Provide drivers for LED lamps that are suitable for the electrical characteristics of the supply circuits to which they are to be connected, and which are suitable for operating the specified lamps.

B. Provide drivers conforming to UL, ETL and ANSI Specifications and displaying labels or symbols of approval by the UL or ETL and of certification as tested by the UL / ETL. Design, fabricate and assemble component parts of drivers in accordance with the latest requirements of the NEC. This Driver protection shall be provided by a built-in self-resetting thermally actuated device that shall remove the driver from line when excessive driver temperature is reached.

C. Rigidly mount drivers to the inside of the top of the fixture housing, with driver surfaces and housing in complete contact for efficient conduction of driver heat, unless specifically indicated to the contrary. Permanently affix driver mounting screws to the fixture housing. Provide only fixtures whose design, fabrication and assembly prevent overheating or cycling of LED's and drivers under any condition of use.

D. Provide identical drivers within each fixture type unless otherwise noted.

E. Switched fixtures which incorporate battery inverter packs for emergency lighting circuits shall include a second "hot leg" conductor to allow for fixtures to be switched without activating the battery inverter pack. Battery inverter packs shall only be activated during loss of normal power.

F. LED light fixtures shall be Reduction of Hazardous Substances (RoHS) – compliant.

G. LED drivers shall include the following features unless otherwise indicated:

1. Minimum efficiency: 85% at full load
2. Minimum Operating Ambient Temperature: -20 C (-4 F).
3. Input Voltage: 120/277V (±10%) at 60Hz.
4. Integral short circuit, open circuit, and overload protection
5. Power Factor: ≥ 0.95.
6. Total Harmonic Distortion: ≤ 20%
7. Comply with FCC 47 CFR Part 15
8. Provide 0-10V dimming controls.

H. LED modules shall include the following features unless otherwise indicated:

1. Comply with IES LM-79 and LM-80 requirements.
2. Minimum color rendering index (CRI) 82.
3. Color temperature shall be 4100K unless otherwise specified in Lighting Fixture Schedule. Color temperature shifts shall comply with ANSI C78 377A for LED binning with further sub-binning restrictions of chromatic to be at or below the visual threshold of perceivable color variation not exceeding the 3 step MacAdam Ellipse line that crosses the black body locus as indicated on the LM79 report. Such restrictions documentation compliance shall be submitted as part of the submittal process.
4. Minimum Rated Life: 50,000 hours per IES L70
5. Light output lumens in accordance to the specified manufacturer and catalog number as indicated in the Lighting Fixture Schedule.

2.7 FIXTURE DESCRIPTIONS

A. Provide fixtures that conform to the above Standards and criteria as indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrate and supporting grids for luminaires.

B. Examine each luminaire to determine suitability for lamps specified.

C. Examine excavation and concrete foundation for lighting poles.

3.2 INSTALLATION

A. Install in accordance with manufacturers instructions, NEC, and as indicated on Drawings.

B. Install suspended luminaires using pendants supported from swivel hangers, 15 degree free swing from vertical, ½ inch hub, 200 pound (minimum) fixture weight. Provide pendant length required to suspend luminaire at indicated height.

C. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

D. Install accessories furnished with each luminaire.

E. Unless otherwise shown, connect emergency lighting units and exit signs to same circuit that feeds the surrounding lighting. Use flexible conduit as indicated.

F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

G. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Adjust exit sign directional arrows as indicated.

B. Replace fixtures that have failed at Substantial Completion.

C. Aim and adjust exterior luminaires to provide illumination levels and distribution as directed.

3.5 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosure.

C. Clean finishes and touch up damage.

D. Clean photometric control surfaces as recommended by manufacturer.

END OF SECTION

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